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UNIVERSAL REMOTE INCLUDING APPARATUS USING
COMPRESSED CODES FOR VIDEO RECORDER CONTROL

Background of the Invention

15 This is a continuation in part of pending Patent
Application Serial No. 07/965,075 filed October 22, 1992,
which is a continuation of pending Patent Application
Serial No. 07/877,687 filed May 1, 1992, now abandoned,
which is a continuation in part of Patent Application
Serial No. 07/829,412 filed February 3, 1992, which is a
20 continuation in part of Serial No. 07/767,323 filed
September 30, 1991, which is a continuation in part of
Serial No. 07/676,934 filed March 27, 1991, which is a
continuation in part of Serial No. 07/371,054 filed
June 26, 1989, now abandoned, which itself is a
25 continuation in part of Serial No. 07/289,369, filed
December 23, 1988, now abandoned.

Field of the Invention

30 This invention relates generally to video cassette
recorder systems and particularly to an apparatus and
method for using encoded information to shorten the time
required to perform timer preprogramming and for remotely
controlling various home electronic devices and an
alternate apparatus and method that itself is easily
35 programmable.

1 Prior Art

 The video cassette recorder (VCR) has a number of
uses, including playing back of tapes filmed by a video
camera, playing back of pre-recorded tapes, and recording
5 and playing back of broadcast and cable television
programs.

 To record a television program in advance of viewing
it, a two-step process is often used: (1) obtain the
correct channel, date, time and length (CDTL) information
10 from a television program guide, and (2) program this CDTL
information into the VCR. Depending on the model, year
and type of the VCR, the CDTL information can be
programmed in various ways including: (i) pushing an
appropriate sequence of keys in the console according to
15 instructions contained in the user's manual, (ii) pushing
an appropriate sequence of keys in a remote hand-held
control unit according to instructions contained in the
user's manual (remote programming), and (iii) executing a
series of keystrokes in the remote hand-held control unit
20 in response to a menu displayed on the television screen
(on-screen programming). Other techniques for timer
preprogramming have been suggested including: (iv) reading
in certain bar-code information using a light pen (light
pen programming), and (v) entering instructions through a
25 computer or telephone modem. These various methods differ
only in the physical means of specifying the information
while the contents, being CDTL and certain
power/clock/timer on-off commands are generally common,
although the detailed protocol can vary with different
30 model VCRs. Methods (i) and (ii) described above can
require up to 100 keystrokes, which has inhibited the free
use of the timer preprogramming feature of VCRs. To
alleviate this, new VCR models have included an "On-Screen
Programming" feature, which permits remote input of CDTL
35 information in response to a menu displayed on the
television screen. Generally on screen programming of
CDTL information requires an average of about 18

1 keystrokes, which is less than some of the prior methods
but still rather substantial. Some of the other
techniques such as (iv) above, require the use of special
equipment such as a bar code reader.

5 In general the present state of the art suffers from
a number of drawbacks. First, the procedure for setting
the VCR to record in advance can be quite complex and
confusing and difficult to learn; in fact, because of this
many VCR owners shun using the timer preprogramming record
10 feature. Second, the transcription of the CDTL
information to the VCR is hardly ever error-free; in fact,
many users of VCR's timer preprogramming features express
concern over the high incidence of programming errors.
Third, even for experienced users, the process of entering
15 a lengthy sequence of information on the channel, date,
time and length of desired program can become tedious.
Fourth, techniques such as reading in bar-code information
or using a computer require special equipment. These
drawbacks have created a serious impedance in the use of
20 a VCR as a recording device for television programs. The
effect is that time shifting of programs has not become as
popular as it once was thought it would be. Accordingly,
there is a need in the art for a simpler system for
effecting VCR timer preprogramming which will enable a
25 user to take advantage of the recording feature of a VCR
more fully and freely.

Summary of the Invention

30 A principal feature of the invention is providing an
improved system for the selection and entering of channel,
date, time and length (CDTL) information required for
timer preprogramming of a VCR which is substantially
simpler, faster and less error-prone than present
techniques. Another principal feature of the invention is
35 providing televisions having an embedded capability for
timer programming control.

1 In accordance with the invention, to program the
timer preprogramming feature of a video system, there is
an apparatus and method for using encoded video
recorder/player timer preprogramming information. The
5 purpose is to significantly reduce the number of
keystrokes required to set up the timer preprogramming
feature on a VCR. In accordance with this invention it is
only necessary for the user to enter a code with 1 to 7
10 digits or more into the VCR. This can be done either
remotely or locally at the VCR. Built into either the
remote controller or the VCR is a decoding means which
automatically converts the code into the proper CDTL
programming information and activates the VCR to record a
15 given television program with the corresponding channel,
date, time and length. Generally multiple codes can be
entered at one time for multiple program selections. The
code can be printed in a television program guide in
advance and selected for use with a VCR or remote
controller with the decoding means.

20 Another principal object of the invention is to embed
the decoding means into a television. The television
would then at the appropriate time distribute the proper
commands to a VCR and a cable box to record the desired
program. The user would use the television remote or
25 controls on the television to enter the code that
signifies the program to be recorded. The same television
remote and controls on the television would also be used
to perform normal television control functions, such as
channel selection. When the codes are entered they are
30 transmitted to the television and the decoder in the
television, which decodes the codes into CDTL information
and then the codes themselves and the CDTL information
could be displayed "on screen" so that the user can verify
that the proper codes have been entered. Then at the
35 appropriate time the television would transmit the proper
commands to a VCR and a cable box, if necessary, to
command the recording of the selected program. This

1 control function can be carried out by using an infrared
link by placing infrared transmitters on the television
cabinet, preferably at the corners. The television
circuitry would include the capability of storing or
5 learning the infrared code protocols for the VCR and the
cable box.

Another principal object of the invention is to embed
the decoding means into various equipments associated with
television, such as a video cassette recorder, cable box
10 or satellite receiver. In any system the decoding means
would only have to be present in one of the equipments,
such as the cable box, which would then at the appropriate
time distribute the proper commands to the other
equipments such as a VCR and a satellite receiver to
15 record the desired program. The user would use the
television remote or controls on the equipment with the
decoder to enter the code that signifies the program to be
recorded. The same television remote would also be used
to perform normal television control functions, such as
20 channel selection. When the codes are entered they are
transmitted to the equipment with the decoder, which
decodes the codes into CDTL information. Then at the
appropriate time the equipment with the decoder would
transmit the proper commands to a the other equipment such
25 as a VCR, satellite receiver and a cable box to command
the recording of the selected program. This control
function can be carried out by using an infrared link by
coupling infrared transmitters on the equipment with the
decoder. The infrared transmitter can be placed in a
30 infrared dome on the equipment, mounted behind the front
panel, attached to a mouse coupled via a cable to the
equipment with the decoder with the mouse placed near the
receiver, or attached to a stick on miniature mouse
coupled via a cable to the equipment with the decoder with
35 the miniature mouse attached to the device with the
receiver. The equipment with the decoder would include
the capability of storing or learning the infrared code

1 protocols for the other equipment, such as a VCR,
satellite receiver and a cable box.

5 Another embodiment of the invention includes a full
function universal remote control capable of controlling
various home electronic devices. The functions of the
buttons of the remote control and the infrared codes
needed to perform the functions are programmed remotely,
such as by transmissions over telephone lines received by
a microphone in the remote control.

10 Other objects and many of the attendant features of
this invention will be more readily appreciated as the
same becomes better understood by reference to the
following detailed descriptions and considered in
connection with the accompanying drawings in which like
15 reference symbols designate like parts throughout the
figures.

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1 Brief Description of the Drawings

5 FIG. 1 is a schematic showing apparatus according to this invention with the code decoder means embedded in the video cassette recorder;

 FIG. 2 is a schematic of the VCR embedded processors for command control and code decoding;

10 FIG. 3 is a schematic showing a preferred embodiment according to this invention with the code decoder means embedded in a remote controller;

 FIG. 4 is a schematic of the processor embedded in the remote controller;

15 FIG. 5 is a schematic of a universal remote controller with the code decoder means embedded in the universal remote controller;

 FIG. 6 is a flow graph of the G-code decoding technique;

 FIG. 7 is a flow graph of the G-code encoding technique;

20 FIG. 8 is an illustration of part of a television calendar according to this invention;

 FIG. 9 is a flow chart for decoding for cable channels;

25 FIG. 10 is a flow chart for encoding for cable channels;

 FIG. 11. is a flow graph of the G-code decoding for cable channels including conversion from assigned cable channel number to local cable carrier channel number;

30 FIG. 12 is a means for decoding including a stack memory;

 FIG. 13 is a flow chart for program entry into stack memory;

 FIG. 14 is an operation flow chart for sending programs from remote control to main unit VCR;

35 FIG. 15 is a perspective view of an apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention;

1 FIG. 16 is a front view of the apparatus of FIG. 15
showing a forward facing light emitting diode;

 FIG. 17 is a perspective view of the apparatus of
FIG. 15 placed in a mounting stand;

5 FIG. 17A is a front elevational view of the apparatus
of FIG. 15 placed in the mounting stand as shown in
FIG. 17;

 FIG. 18 is a detail of the LCD display of the
apparatus of FIG. 15;

10 FIG. 19 is a perspective view showing a manner of
placing the apparatus of FIG. 15 relative to a cable box
and a VCR;

 FIG. 20 is a perspective view showing a manner of
placing the mounting stand with the apparatus of FIG. 15
mounted thereon near a cable box and VCR;

15 FIG. 21 is a schematic showing apparatus for using
compressed codes for recorder preprogramming according to
a preferred embodiment of the invention;

 FIG. 22 is a detailed schematic showing a preferred
20 embodiment of apparatus implementing the schematic of
FIG. 21;

 FIG. 23 is a flow graph for program entry into the
apparatus of FIG. 15;

 FIG. 24 is a flow graph for review and program
25 cancellation of programs entered into the apparatus of
FIG. 15;

 FIG. 25 is a flow graph for executing recorder
preprogramming using compressed codes according to a
preferred embodiment of the invention;

30 FIG. 26 is a flow graph for encoding program channel,
date, time and length information into decimal compressed
codes;

 FIG. 27 is a flow graph for decoding decimal
compressed codes into program channel, date, time and
length information;

35 FIG. 28 is an embodiment of an assigned channel
number/local channel number table;

1 FIG. 29 block diagram of a system including a television having a G-code decoder;

 FIG. 30 is a schematic of a television having a G-code decoder;

5 FIG. 31 is a schematic showing apparatus for a G-code decoder in a television having G-code decoding;

 FIG. 32 is a block diagram of a system including a television having a G-code decoder, a VCR, a cable box and a satellite receiver;

10 FIG. 33 is a block diagram of a system including a VCR having a G-code decoder, a television, a cable box and a satellite receiver;

 FIG. 34 is a block diagram of a system including a cable box having a G-code decoder, a television, a VCR, and a satellite receiver;

15 FIG. 35 is a block diagram of a system including a satellite receiver having a G-code decoder, a television, a VCR, and a cable box;

 FIG. 36 is a perspective view showing a cable box placed on top of a VCR having an infrared transmitter behind the front panel which communicates to the cable box infrared receiver via reflection;

 FIG. 37 is a perspective view showing a cable box placed on top of a VCR having an infrared transmitter inside a infrared dome on the top of the VCR which communicates to the cable box infrared receiver;

25 FIG. 38 is a perspective view of a VCR having an infrared transmitter inside a mouse coupled via a cable to the VCR with the mouse placed near the cable box infrared receiver; and

30 FIG. 39 is a perspective view of a VCR having an infrared transmitter inside a miniature mouse coupled via a cable to the VCR with the miniature mouse stuck onto the cable box near the infrared receiver.

35 FIG. 40 is a perspective view of a second apparatus for using compressed codes for recorder preprogramming according to a preferred embodiment of the invention.

1 FIG. 41 is a bottom view of the apparatus of FIG. 41
showing a microphone hole and two electrical contact
holes.

5 FIG. 42 shows the apparatus of FIG. 40 being used in
conjunction with a telephone.

FIG. 43 is a schematic showing second apparatus for
using compressed codes for recorder preprogramming
according to a preferred embodiment of the invention.

10 FIG. 44 is an alternate schematic showing second
apparatus for using compressed codes for recorder
preprogramming according to a preferred embodiment of the
invention.

15 FIG. 45 is a perspective view of an apparatus for
programming remote controls with memories according to a
preferred embodiment of the invention.

FIG. 46 is a perspective view of the apparatus of
FIG. 45 with the hinged lid in the open position.

FIG. 47 is a rear view of the apparatus of FIG. 45
showing telephone and computer input/output ports.

20 FIG. 48 is a bottom view of the apparatus of FIG. 15
showing electrical contact access holes.

FIG. 49 is a perspective view of the apparatus of
FIG. 45 coupled to an apparatus according to FIG. 15.

25 FIG. 50 is a perspective view of the apparatus of
FIG. 45 coupled to an apparatus according to FIG. 40.

FIG. 51 is a schematic showing apparatus for
programming remote controls with memories according to a
preferred embodiment of the invention.

30 FIG. 52 is a schematic showing the electronic
connection between apparatus for programming remote
controls with memories according to a preferred embodiment
of the invention and a personal computer.

35 FIG. 53 is a perspective view of a complete universal
remote control capable of using compressed codes for
recorder preprogramming according to a preferred
embodiment of the invention.

FIG. 54 is a front view of the apparatus of FIG. 53.

- 1 FIG. 55 is a side view of the apparatus of FIG. 53
showing a microphone opening and an electrical contact
access hole.
- FIG. 56 is a rear view of the apparatus of FIG. 53.
- 5 FIG. 57 is a back view of the apparatus of FIG. 53
showing electrical contact access holes.
- FIG. 58 is a block schematic of an embodiment of the
apparatus of FIG. 53.
- 10 FIG. 59 is a block schematic of an alternative
embodiment of the apparatus of FIG. 53.
- FIG. 60 is a flow chart of the process of remotely
programming the apparatus of FIG. 53 over telephone lines.
- FIG. 61 shows the apparatus of FIG. 53 in its upright
position, resting on a coffee table on the apparatus' rear
15 surface.
- FIG. 62 is a cross sectional view taken along line
7-7 of FIG. 53.
- FIG. 63 is a cross sectional view taken along line
8-8 of FIG. 53.
- 20 FIG. 64 is a cross sectional view taken along line
9-9 of FIG. 53.
- FIG. 65 is a perspective view of an alternative
embodiment of the remote control of FIG. 53.
- FIG. 66 is a top view of the remote control of
25 FIG. 65.
- FIG. 67 is a side view of the remote control of
FIG. 65.
- FIG. 68 is a front view of the remote control of
FIG. 65.
- 30 FIG. 69 is a rear view of the remote control of
FIG. 65.
- FIG. 70 is a bottom view of the remote control of
FIG. 65.
- FIG. 71 is a perspective view of a second alternative
embodiment of the remote control of FIG. 53.
- 35 FIG. 72 is a top view of the remote control of
FIG. 71.

1 FIG. 73 is a side view of the remote control of
FIG. 71.

FIG. 74 is a rear view of the remote control of
FIG. 71.

5 FIG. 75 is a front view of the remote control of
FIG. 71.

FIG. 76 is a bottom view of the remote control of
FIG. 71.

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1 Detailed Description

 Referring now to the drawings, and more particularly,
to FIG. 1, there is shown an apparatus for using encoded
video recorder/player timer preprogramming information 10
5 according to this invention. The primary components
include a remote controller 12 and a video cassette
recorder/player with G-code decoder 14, which can be
controlled by remote controller 12 via a command signal
16. The remote controller 12 can have a number of keys,
10 which include numerical keys 20, G-code switch 22,
function keys 24, program key 26 and power key 27. There
are means in the remote controller 12 that interprets each
key as it is pressed and sends the proper command signal
16 to the VCR via an infra-red light emitting diode 28.
15 Except for the G-code switch 22 on the remote controller
12 in FIG. 1, the remote controller 12 is essentially the
same as any other remote controller in function. The
G-code switch 22 is provided just to allow the user to
lock the remote controller 12 in the G-code mode while
20 using a G-code, which is the name given to the compressed
code which is the encoded CDTL information, to perform
timer preprogramming.

 A G-code consists of 1 to 7 digits, although more
could be used, and is associated with a particular
25 program. A user would look up the G-code in a program
guide and just enter the G-code on the remote controller
12, instead of the present state of the art, which
requires that the user enter the actual channel, date
time and length (CDTL) commands.

30 In order to understand the advantages of using a
G-code, it is helpful to describe the best of the current
state of the art, which is "on screen programming" with
direct numerical entry. This technique involves about 18
keystrokes and the user has to keep switching his view
35 back and forth between the TV screen and the remote
controller while entering the CDTL information. This
situation may be akin to a user having to dial an 18 digit

1 telephone number while reading it from a phone book. The
number of keys involved and the switching back and forth
of the eye tend to induce errors. A typical keying
sequence for timer recording using on-screen CDTL
5 programming is as follows:

PROG 2 1 15 07 30 2 08 00 2 04 PROG

10 The first program (PROG) key 26 enters the programming
mode. Then a sequence of numerical keys 20 are pushed.
The 2 means it is timer recording rather than time
setting. The 1 means the user is now entering the
settings for program 1. The 15 is the date. The 07 is
15 pm. The next sequence 08 00 2 is the stopping time. The
04 is channel number. Finally, the PROG is hit again to
exit the program mode.

By contrast, this command could have been "coded" and
entered in a typical G-code sequence as follows: PROG
20 1138 PROG. To distinguish that the command is a coded
G-code, the G-code switch 22 should be turned to the "ON"
position. Instead of having a switch, a separate key "G"
can be used. The G-code programming keystroke sequence
would then be: G 1138 PROG.

25 The use of a G-code does not preclude "on-screen"
confirmation of the program information that has been
entered. When the keystrokes "PROG 1138 PROG" are entered
with the G-code switch in the "ON" position, the G-code
30 would be decoded and the television could display the
following message:

| PROGRAM | DATE | START TIME | STOP TIME | CHANNEL |
|---------|------|------------|-----------|---------|
| 1138 | 15 | 7:30 PM | 8:00 PM | 4 |

35 In order for the G-code to be useful it must be
decoded and apparatus for that purpose must be provided.
Referring to FIG. 1, a video cassette recorder/player with

1 G-code decoder 14 is provided to be used in conjunction
with remote controller 12. The command signal 16 sent
from the remote controller 12 is sensed by the photodiode
32 and converted to electrical signals by command signal
5 receiver 30. The electrical signals are sent to a command
controller 36, which interprets the commands and
determines how to respond to the commands. As shown in
FIG. 1, it is also possible for the command controller 36
to receive commands from the manual controls 34 that are
10 normally built into a VCR. If the command controller 36
determines that a G-code was received then the G-code will
be sent to the G-code decoder 38 for decoding. The G-code
decoder 38 converts the G-code into CDTL information,
which is used by the command controller 36 to set the
15 time/channel programming 40. Built into the VCR is a
clock 42. This is normally provided in a VCR and is used
to keep track of the date and time. The clock 42 is used
primarily by the time/channel programming 40 and the
G-code decoder 38 functions. The time/channel programming
20 40 function is set up with CDTL information by the command
controller 36. When the proper date and time is read from
clock 42, then the time/channel programming 40 function
turns the record/playback 44 function "ON" to record. At
the same time the tuner 46 is tuned to the proper channel
25 in the television signal 18. Later the user can command
the record/playback 44 function to a playback mode to
watch the program via the television monitor 48.

An alternate way to control the recorder is to have
the command controller 36 keep all the CDTL information
30 instead of sending it to the time/channel programming 40.
The command controller would also keep track of the time
by periodically reading clock 42. The command controller
would then send commands to the time/channel programming
40 to turn on and off the recorder and to tuner 46 to
35 cause it to tune to the right channel at the right time
according to the CDTL information.

1 The clock 42 is also an input to G-code decoder 38,
which allows the G-code decoding to be a function of the
clock, which lends a measure of security to the decoding
technique and makes it harder to copy. Of course this
5 requires that the encoding technique must also be a
function of the clock.

A possible realization of the command controller 36
and the G-code decoder 38 is shown in FIG. 2. The command
controller 36 function can be realized with a
10 microprocessor 50, a random access memory 52 and a read
only memory 54, which is used for program storage. The
input/output 56 function is adapted to receive commands
from the command signal receiver 30, the manual controls
34 and the clock 42, and to output signals to a display
15 35, the clock 42, and the time/channel programming 40
function. If the microprocessor 50 interprets that a
G-code has been received, then the G-code is sent to
microcontroller 60 for decoding. The microcontroller 60
has an embedded random access memory 62 and an embedded
20 read only memory 64 for program and table storage. The
clock 42 can be read by both microprocessor 50 and
microcontroller 60.

An alternative to having microcontroller 60 perform
the G-code decoding is to build the G-code decoding
25 directly into the program stored in read only memory 54.
This would eliminate the need for microcontroller 60. Of
course, other hardware to perform the G-code decoding can
also be used. The choice of which implementation to use
is primarily an economic one.

30 The blocks in Figs. 1 and 2 are well known in the
prior art and are present in the following patents:
Fields, patent no. 4,481,412; Scholz, patent no.
4,519,003; and Brugliera, patent no. 4,631,601. For
example, clock 42 is analogous to element 7 in Scholz and
35 element 17 in Brugliera. Other analogous elements are:
command signal receiver 30 and Scholz 14 and Brugliera 12;
tuner 46 and Scholz 6 and Brugliera 10; time/channel

1 programming 40 and Scholz 8, 11 and Brugliera 16; record
& playback 44 and Scholz 1, 2, 4; command controller 36
and Scholz 11, 10 and Brugliera 12; microprocessor 50 and
Fields 27; RAM 52 and Fields 34; ROM 54 and Fields 33;
5 manual controls 34 and Scholz 15, 16; and remote
controller 12 and Scholz 26 and Brugliera 18.

FIG. 3 illustrates an alternate preferred embodiment
of this invention. In FIG. 3 a remote controller with
embedded G-code decoder 80 is provided. The remote
10 controller with embedded G-code decoder 80 is very similar
to remote controller 12, except for the addition of the
G-code decoder 82. Note that it is also possible in any
remote controller to provide a display 84. The remote
controller with embedded G-code decoder 80 would be used
15 in conjunction with a normal video cassette
recorder/player 70, which would not be required to have an
embedded G-code decoder. The numerals for the subelements
of video cassette recorder/player 70 are the same as
described above for the video cassette recorder/player
20 with G-code decoder 14 and have the same function, except
for the absence of G-code decoder 38. This preferred
embodiment has the advantage that it can be used in
conjunction with VCRs that are presently being used.
These do not have a G-code decoding capability. Replacing
25 their remote controllers with ones that have this
capability built-in can vastly improve the capability to
do timer preprogramming for a modest cost.

FIG. 4 illustrates a possible realization of the
G-code decoder 82 built into the remote controller with
30 embedded G-code decoder 80. A microcontroller 60 can be
used as before to decode the G-code, as well as interface
with the display 84, a clock 85, the keypad 88 and the
light emitting diode 28. Alternately, other hardware
implementations can be used to perform the G-code
35 decoding. The clock 85 is provided in the remote
controller 80 so that the G-code decoder 82 can be made to
have the clock 85 as one of its inputs. This allows the

1 G-code decoding to be a function of the clock 85, which
lends a measure of security to the decoding technique and
makes it harder to copy.

5 The remote controller with embedded G-code decoder as
described above would send channel, date, time and length
information to the video cassette recorder/player 70,
which would use the CDTL information for tuning into the
correct channel and starting and stopping the recording
function. The remote controller may have to be unique for
10 each different video cassette recorder/player, because
each brand or model may have different infrared pulses for
each type of information sent such as the channel number
keys and start record and stop record keys. The
particular infrared pulses used for each key type can be
15 called the vocabulary of the particular remote controller.
Each model may also have a different protocol or order of
keys that need to be pushed to accomplish a function such
as timer preprogramming. The protocol or order of keys to
accomplish a function can be called sentence structure.
20 If there is a unique remote controller built for each
model type, then the proper vocabulary and sentence
structure can be built directly into the remote
controller.

25 An alternate to having the remote controller with
embedded G-code decoder send channel, date, time and
length information to the video cassette recorder/player
70, is to have the remote controller with embedded G-code
decoder perform more operations to simplify the
interfacing problem with existing video cassette
30 recorder/players. In particular, if the remote
controller not only performs the G-code decoding to CDTL,
but also keeps track of time via clock 85, then it is
possible for the remote controller to send just channel,
start record and stop commands to the video cassette
35 recorder/player. The channel, start and stop are usually
basic one or two key commands, which means there is no
complicated protocol or sentence structure involved.

1 Thus, to communicate with a diverse set of video cassette
recorder/player models it is only necessary to have memory
within the remote controller, such as ROM 64 of FIG. 4,
for storing the protocol for all the models or at least a
5 large subset. The G-code would be entered on the remote
controller as before and decoded into channel, date, time
and length information, which would be stored in the
remote controller. Via clock 85, the time would be
checked and when the correct time arrives the remote
10 controller would automatically send out commands to the
VCR unit for tuning to the correct channel and for
starting and stopping the recording. It is estimated that
only two (2) bytes per key for about 15 keys need to be
stored for the vocabulary for each video cassette
15 recorder/player model. Thus, to cover 50 models would
only require about $30 \times 50 = 1500$ bytes of memory in the
remote controller. It would be necessary to position the
remote controller properly with respect to the VCR unit so
that the infrared signals sent by the remote controller
20 are received by the unit.

Another preferred embodiment is to provide a
universal remote controller 90 with an embedded G-code
decoder. Universal remote controllers provide the
capability to mimic a number of different remote
25 controllers. This reduces the number of remote
controllers that a user needs to have. This is
accomplished by having a learn function key 94 function on
the universal remote controller, as shown in FIG. 5. If
the learn function key 94 is pushed in conjunction with
30 another key, the unit will enter into the learn mode.
Incoming infra-red (IR) pulses from the remote controller
to be learned are detected by the infra-red photodiode 96,
filtered and wave-shaped into recognizable bit patterns
before being recorded by a microcontroller into a
35 battery-backed static RAM as the particular IR pulse
pattern for that particular key. This is done for all the
individual keys.

1 An example of more complex learning is the following.
If the learn function key 94 in conjunction with the
program key 26 are pushed when the G-code switch is "ON",
the unit will recognize that it is about to record the
5 keying sequence of a predetermined specific example of
timer preprogramming of the particular VCR involved. The
user will then enter the keying sequence from which the
universal remote controller 90 can then deduce and record
the protocol of the timer preprogramming sequence. This
10 is necessary because different VCRs may have different
timer preprogramming command formats.

If keys are pushed without the learn function key 94
involved, the microcontroller should recognize it is now
in the execute mode. If the key is one of the direct
15 command keys, the microcontroller will read back from its
static RAM the stored pulse sequence and send out command
words through the output parallel I/O to pulse the output
light emitting diode 28. If the key is the PROG key and
the G-code switch is "OFF", then the microcontroller
20 should recognize the following keys up to the next PROG
key as a timer preprogramming CDTL command and send it out
through the light emitting diode 28. If the G-code switch
22 is set to "ON" and the program key 26 is pushed, the
microcontroller should recognize the following keys up to
25 the next PROG key as a G-code command for timer
preprogramming. It will decode the G-code into channel,
date, start time and length (CDTL) and the microcontroller
will then look up in its static RAM "dictionary" the
30 associated infra-red pulse patterns and concatenate them
together before sending them off through the output
parallel I/O to pulse the light emitting diode 28 to send
the whole message in one continuous stream to the VCR.

FIG. 4 illustrates a possible realization of the
G-code decoder 92 that could be built into the universal
35 remote controller with embedded G-code decoder 90. A
microcontroller 60 can be used as before to decode the
G-code, as well as for interfacing with the input/output

1 functions including the photodiode 96. Alternately, the
G-code decoding can be performed with other hardware
implementations.

5 The universal remote controller can also be used in
another manner to simplify the interfacing problem with
existing video cassette recorder/players. In particular,
if the universal remote controller performs not only the
G-code decoding to CDTL, but also keeps track of time via
10 clock 85 in FIG. 4, then it is possible for the universal
remote controller to send just channel, start record and
stop commands to the video cassette recorder/player, which
as explained before, are usually basic one key commands,
which means there is no complicated protocol or sentence
15 structure involved. Thus, to communicate with a diverse
set of video cassette recorder/player models it is only
necessary for the universal remote controller to "learn"
each key of the remote controller it is replacing. The
G-code would be entered on the universal remote controller
as before and decoded into channel, date, time and length
20 information, which would be stored in the universal remote
controller. Via clock 85, the time would be checked and
when the correct time arrives the universal remote
controller would automatically send out commands to the
VCR unit for tuning to the correct channel and for
25 starting and stopping the recording. It would be
necessary to position the universal remote controller
properly with respect to the VCR unit so that the signals
sent by the universal remote are received by the VCR unit.

30 There are a number of ways that the G-code decoding
can be performed. The most obvious way is to just have a
large look up table. The G-code would be the index.
Unfortunately, this would be very inefficient and result
in a very expensive decoder due to the memory involved.
The total storage involved is a function of the number of
35 total combinations. If we allow for 128 channels, 31 days
in a month, 48 on the hour and on the half hour start
times in a twenty four hour day, and 16 length selections

1 in half hour increments, then the total number of
combinations is $128 \times 31 \times 48 \times 16 = 3,047,424$. This number of
combinations can be represented by a 7 digit number. The
address to the table would be the 7 digit number. In the
5 worst case, this requires a look up table that has about
4,000,000 rows by 15 to 16 digital columns, depending on
the particular protocol. These digital columns would
correspond to the CDTL information required for "on screen
programming". Each digit could be represented by a 4 bit
10 binary number. Thus, the total storage number of bits
required for the look up table would be about
 $4,000,000 \times 16 \times 4 = 256,000,000$. The present state of the
art has about 1 million bits per chip. Thus, G-code
decoding using a straightforward table look up would
15 require a prohibitively expensive number of chips.

Fortunately, there are much more clever ways of
performing the G-code decoding. FIG. 6 is a flow diagram
of a preferred G-code decoding technique. To understand
G-code decoding, it is easiest to first explain the G-code
20 encoding technique, for which FIG. 7 is the flow chart.
Then the G-code decoding technique, which is the reverse
of the G-code encoding will be explained.

The encoding of the G-codes can be done on any
computer and is done prior to preparation of any program
25 guide that would include G-codes. For each program that
will be printed in the guide, a channel, date, time and
length (CDTL) code 144 is entered in step 142. Step 146
separately reads the priority for the channel, date, time
and length in the priority vector storage 122, which can
30 be stored in read only memory 64. The priority vector
storage 122 contains four tables: a priority vector C
table 124, a priority vector D table 126, a priority
vector T table 128 and a priority vector L table 130.

The channel priority table is ordered so that the
35 most frequently used channels have a low priority number.

1 An example of the data that is in priority vector C table
124 follows.

| | | | | | | | | | |
|----------|---|---|---|---|---|---|----|----|-----|
| channel | 4 | 7 | 2 | 3 | 5 | 6 | 11 | 13 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

5

Generally the dates of a month all have an equal priority, so the low number days in a month and the low number priorities would correspond in the priority vector D table as in the following example.

10

| | | | | | | | | | |
|----------|---|---|---|---|---|---|---|---|-----|
| date | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

15

The priority of the start times would be arranged so that prime time would have a low priority number and programs in the dead of the night would have a high priority number. For example, the priority vector T table would contain:

20

| | | | | | |
|----------|--------|--------|--------|--------|-----|
| time | 6:30pm | 7:00pm | 8:00pm | 7:30pm | ... |
| priority | 0 | 1 | 2 | 3 | ... |

An example of the data that is in the priority vector L table 130 is the following:

25

| | | | | | | |
|---------------------------|-----|-----|-----|-----|-----|-----|
| length of program (hours) | 0.5 | 1.0 | 2.0 | 1.5 | 3.0 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | ... |

30 Suppose the channel date time length (CDTL) 144 data is 5 10 19.00 1.5, which means channel 5, 10th day of the month, 7:00 PM, and 1.5 hours in length, then for the above example the C_p, D_p, T_p, L_p data 148, which are the result of looking up the priorities for channel, date, time and length in priority tables 124, 126, 128 and 130 of FIG. 7,
35 would be 4 9 1 3. Step 150 converts C_p, D_p, T_p, L_p data to binary numbers. The number of binary bits in each

1 conversion is determined by the number of combinations
involved. Seven bits for C_p , which can be denoted as C_7 ,
 $C_6, C_5, C_4, C_3, C_2, C_1$, would provide for 128 channels. Five bits
for D_p , which can be denoted as D_5, D_4, D_3, D_2, D_1 , would
5 provide for 31 days in a month. Six bits for T_p , which
can be denoted as $T_6, T_5, T_4, T_3, T_2, T_1$, would provide for 48
start times on each half hour of a twenty four hour day.
Four bits for length, which can be denoted as L_4, L_3, L_2, L_1 ,
would provide for a program length of up to 8 hours in
10 half hour steps. Together there are $7+5+6+4 = 22$ bits of
information, which correspond to $2^{22} = 4,194,304$ combinations.

The next step is to use bit hierarchy key 120, which
can be stored in read only memory 64 to reorder the 22
15 bits. The bit hierarchy key 120 can be any ordering of
the 22 bits. For example, the bit hierarchy key might be:

| | | | | | | | | | | | | |
|-------|-------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| L_4 | C_7 | ... | T_1 | C_2 | T_1 | C_1 | L_1 | D_5 | D_4 | D_3 | D_2 | D_1 |
| 22 | 21 | ... | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

20

Ideally the bit hierarchy key is ordered so that
programs most likely to be the subject of timer
preprogramming would have a low value binary number, which
would eliminate keystrokes for timer preprogramming the
25 most popular programs. Since all the date information has
equal priority, then the D_5, D_4, D_3, D_2, D_1 bits are first.
Next T_1, C_1, L_1 are used, because for whatever date it is
necessary to have a time channel and length and T_1, C_1, L_1
30 are the most probable in each case due to the ordering of
the priority vectors in priority vector storage 122. The
next bit in the hierarchy key is determined by the
differential probabilities of the various combinations.
One must know the probabilities of all the channels, times
35 and lengths for this calculation to be performed.

1 For example, the probability for channels may be:

5

| | | | | | | | | | |
|----------------|---|-----|---|---|-----|-----|----|-----|-----|
| channel | 4 | 7 | 2 | 3 | 5 | 6 | 11 | 13 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |
| probability(%) | 5 | 4.3 | 4 | 3 | 2.9 | 2.1 | 2 | 1.8 | ... |

The probabilities for times might be:

10

| | | | | | |
|----------------|--------|--------|--------|--------|-----|
| time | 6:30pm | 7:00pm | 8:00pm | 7:30pm | ... |
| priority | 0 | 1 | 2 | 3 | ... |
| probability(%) | 8 | 7.8 | 6 | 5 | ... |

And, the probabilities for lengths might be:

15

| | | | | | | |
|---------------------------|-----|-----|-----|-----|-----|-----|
| length of program (hours) | 0.5 | 1.0 | 2.0 | 1.5 | 3.0 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | ... |
| probability(%) | 50 | 20 | 15 | 5 | 4 | ... |

20 The probabilities associated with each channel, time and length, as illustrated above, are used to determine the proper ordering. Since the priority vector tables are already ordered by the most popular channel, time, and length, the order in which to select between the various binary bits for one table, for example selecting between

25 the $C_7, C_6, C_5, C_4, C_3, C_2, C_1$ bits, is already known. The C_1 bit would be selected first because as the lowest order binary bit it would select between the first two entries in the channel priority table. Then the C_2 bit would be selected and so on. Similarly, the T_1 and L_1 bits would be used

30 before any of the other time and length bits. A combination of the C_1, T_1, L_1 and D_3, D_4, D_3, D_2, D_1 bits should be used first, so that all the information is available for a channel, date, time and length. The D_3, D_4, D_3, D_2, D_1 bits are all used because the date bits all have equal

35 priority and all are needed to specify a date even if some of the bits are binary zero.

1 At this point the bit hierarchy key could be:

$T_1, C_1, L_1, D_3, D_4, D_5, D_2, D_1$

5 The first channel binary bit C_1 by itself can only select between $2^1 = 2$ channels, and the first two channels have a probability percent of 5 and 4.3, respectively. So the differential probability of C_1 is 9.3. Similarly, the differential probability of T_1 is $8 + 7.8 = 15.8$, and the
10 differential probability of L_1 is $50 + 20 = 70$. If the rules for ordering the bit hierarchy key are strictly followed, then the first 8 bits of the bit hierarchy key should be ordered as:

15 $C_1, T_1, L_1, D_3, D_4, D_5, D_2, D_1,$

because L_1 has the highest differential priority so it should be next most significant bit after D_1 , followed by T_1 as the next most significant bit, and then C_1 as the
20 next most significant bit. Notice that the bit hierarchy key starts with the least significant bit D_1 , and then is filled in with the highest differential probability bits. This is for the purpose of constructing the most compact codes for popular programs.

25 The question at this point in the encoding process is what should the next most significant bit in the hierarchy key be: T_1 , C_2 , or L_2 . This is again determined by the differential probabilities, which can be calculated from
30 the above tables for each bit. Since we are dealing with binary bits, the C_2 in combination with C_1 selects between $2^2 = 4$ channels or 2 more channels over C_1 alone. The differential probability for C_2 is then the additional probabilities of these two additional channels and for the example this is: $4 + 3 = 7$. In a similar manner C_3 in
35 combination with C_1 and C_2 selects between $2^3 = 8$ channels or $4 = 2^{(2-1)}$ more channels over the combination of C_1 and C_2 .

1 So the differential probability of C_1 is the additional
probabilities of these four additional channels and for
the example this is: $2.9 + 2.1 + 2 + 1.8 = 8.8$. In a
similar manner, the differential probabilities of T_1 and
5 L_1 can be calculated to be $6 + 5 = 11$ and $15 + 5 = 20$,
respectively. Once all the differential probabilities are
calculated, the next step is determining which
combinations of bits are more probable.

Now for the above example, which combination is more
10 probable: T_1 with C_1 , L_1 , or C_2 with T_1 , L_1 , or L_2 with T_1 , C_1 .
This will determine the next bit in the key. So, which is
greater: $11 \times 9.3 \times 70 = 7161$; $7 \times 15.8 \times 70 = 7742$; or $20 \times 15.8 \times 9.3 =$
 2938.8 ? In this case the combination with the greatest
probability is $7 \times 15.8 \times 70 = 7742$, which corresponds to C_2
15 with T_1 , L_1 . So, C_2 is selected as the next bit in the bit
hierarchy key.

The next bit is selected in the same way. Which
combination is more probable: C_1 with T_1 , L_1 , or T_2 with C_1 ,
or C_2 and L_1 , or L_2 with C_1 or C_2 and T_1 . For the example
20 shown, which has the greatest probability: $8.8 \times 15.8 \times 70 =$
 9732.8 ; $11 \times (9.3 + 7) \times 70 = 12551$; or $20 \times (9.3 + 7) \times 15.8 = 5150.8$?
In this case the combination with the greatest probability
is $11 \times (9.3 + 7) \times 70 = 12551$, which corresponds T_2 with C_1 or C_2
and L_1 . So, T_2 is selected as the next bit in the bit
25 hierarchy key. This procedure is repeated for all the
differential probabilities until the entire key is found.

Alternately, the bit hierarchy key can be just some
arbitrary sequence of the bits. It is also possible to
make the priority vectors interdependent, such as making
30 the length priority vector dependent on different groups
of channels. Another technique is to make the bit
hierarchy key 120 and the priority vector tables 122, a
function of clock 42, as shown in FIG. 7. This makes it
very difficult for the key and therefore the coding
35 technique to be duplicated or copied.

1 For example it is possible to scramble the date bits
in the bit hierarchy key 120 as a function of the clock.
Changing the order of the bits as a function of the clock
would not change the effectiveness of the bit hierarchy
5 key in reducing the number of binary bits for the most
popular programs, because the date bits all are of equal
priority. This could be as simple as switching the D_1 and
 D_3 bits periodically, such as every day or week. Thus
the bit hierarchy key 120 would switch between

10

... $C_1 T_1 L_1 D_3 D_4 D_3 D_2 D_1$ and

... $C_1 T_1 L_1 D_1 D_4 D_3 D_2 D_3$.

15 Clearly other permutations of the bit hierarchy key as a
function of the clock are possible.

The priority vector tables could also be scrambled as
a function of the clock. For example, the first two
channels in the priority channel table could just be
20 swapped periodically. If this technique is followed, then
the C_p of 148 in FIG. 7 would change as a function of the
clock 42. For example,

25

| | | | | | | | | | |
|----------|---|---|---|---|---|---|----|----|-----|
| channel | 4 | 7 | 2 | 3 | 5 | 6 | 11 | 13 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

would change periodically to:

30

| | | | | | | | | | |
|----------|---|---|---|---|---|---|----|----|-----|
| channel | 7 | 4 | 2 | 3 | 5 | 6 | 11 | 13 | ... |
| priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

35 This would be a fairly subtle security technique,
because a decoder that was otherwise correct would only
fail if those first two channels were being used. Other
clock dependencies are also possible to provide security
for the coding technique.

1 However it is derived, the bit hierarchy key 120 is
determined and stored. In step 154 the binary bits of
C_p, D_p, T_p, L_p are rearranged according to the bit hierarchy
key 120 to create one 22 bit binary number. Then the
5 resulting 22 bit binary number is converted to decimal in
the convert binary number to decimal G-code step 156. The
result is G-code 158.

10 If the priority vector and the bit hierarchy key are
well matched to the viewing habits of the general
population, then it is expected that the more popular
programs would require no more than 3 or 4 digits for the
G-code.

15 Now that the encoding technique has been explained
the decoding technique is just reversing the coding
technique. This is done according to the flow chart of
FIG. 6. This is the preferred G-code decoding that can be
built into G-code decoder 38 in VCR 14 or the remote
controller G-code decoders 82 and 92 in FIGs. 3 and 5.

20 The first step 102 is to enter G-code 104. Next the
G-code 104 is converted to a 22 bit binary number in step
106. Then the bits are reordered in step 108 according to
the bit hierarchy key 120 to obtain the reordered bits
110. Then the bits are grouped together and converted to
decimal form in step 112. As this point we obtain
25 C_p, D_p, T_p, L_p data 114, which are the indices to the priority
vector tables. For the above example, we would have at
this step the vector 4 9 1 3. This C_p, D_p, T_p, L_p data 114 is
then used in step 116 to look up channel, date, time, and
length in priority vector storage 122. The CDTL 118 for
30 the example above is 5 10 19.00 1.5, which means channel
5, 10th day of the month, 7:00 PM, and 1.5 hours in
length.

35 If the coding technique is a function of the clock
then it is also necessary to make the decoding technique
a function of the clock. It is possible to make the bit
hierarchy key 120 and the priority vector tables 122, a

1 function of clock 42, as shown in FIG. 6. This again
makes it very difficult for the key and therefore the
coding technique to be duplicated or copied. It is also
possible to have the decoding and encoding techniques
5 dependent on any other predetermined or preprogrammable
algorithm.

Although the above G-code encoding and decoding
technique is a preferred embodiment, it should be
understood that there are many ways to perform the intent
10 of the invention which is to reduce the number of
keystrokes required for timer preprogramming. To
accomplish this goal there are many ways to perform the
G-code encoding and decoding. There are also many ways to
make the encoding and decoding technique more secure
15 besides just making the encoding and decoding a function
of the clock. This security can be the result of any
predetermined or preprogrammed algorithm.

It is possible in the G-code coding and decoding
techniques to use mixed radix number systems instead of
20 binary numbers. For example, suppose that there are only
35 channels, which would require 6 binary bits to be
represented; however, 6 binary bits can represent 64
channels, because $2^6 = 64$. The result is that in a binary
number system there are 29 unnecessary positions. This
25 can have the effect of possibly making a particular G-code
longer than it really needs to be. A mixed radix number
system can avoid this result. For example, for the case
of 35 channels, a mixed radix number system with the
factors of 7^1 and 5^0 can represent 35 combinations without
30 any empty space in the code. The allowed numbers for the
 7^1 factor are 0, 1, 2, 3, and 4. The allowed numbers for
the 5^0 factor are 0, 1, 2, 3, 4, 5, and 6. For example,
digital 0 is represented in the mixed radix number system
as 00. The digital number 34 is represented in the mixed
35 radix number system as 46, because $4*7^1 + 6*5^0 = 34$. The
major advantage of a mixed radix number system is in

1 prioritizing the hierarchy key. If the first 5 channels
have about equal priority and the next 30 are also about
equal, then the mixed radix number system allows the two
tiers to be accurately represented. This is not to say
5 that a mixed radix number system is necessarily
preferable. Binary numbers are easier to represent in a
computer and use of a fixed radix number system such as
binary numbers allows a pyramid of prioritization to be
easily represented in the hierarchy key.

10 Another feature that is desirable in all of the
embodiments is the capability to key in the G-code once
for a program and then have the resulting CDTL information
used daily or weekly. Ordinarily the CDTL information is
discarded once it is used. In the case of daily or weekly
15 recording of the same program, the CDTL information is
stored and used until it is cancelled. The desire to
repeat the program daily or weekly can be performed by
having a "WEEKLY" or "DAILY" button on the remote
controller or built into the VCR manual controls. Another
20 way is to use one key, such as the PROG key and push it
multiple times within a certain period of time such as
twice to specify daily or thrice to specify weekly. For
example, if the G-code switch is "ON" and the G-code for
the desired program is 99 then daily recording of the
25 program can be selected by the following keystrokes:

"PROG 99 DAILY PROG"

or by:

"PROG 99 PROG PROG".

The G-code 99 would be converted to CDTL information,
30 which would be stored and used daily in this case. The
recording would begin on the date specified and continue
daily after that using the same channel time and length
information. A slight twist is that daily recording could
be automatically suspended during the weekends, because
35 most daily programs are different on Saturday and Sunday.

Once a daily or weekly program is set up, then it can
be used indefinitely. If it is desired to cancel a

1 program and if there is a "CANCEL" button on the remote
controller or manual control for the VCR, then one way to
cancel a program (whether it is a normal CDTL, daily or
weekly entry) is to key in the following:

5 "PROG xx CANCEL", where xx is the G-code.
Again as before there are alternate ways of accomplishing
this.

If "on screen programming" is available, then the
programs that have been selected for timer preprogramming
10 could be reviewed on the screen. The daily and weekly
programs would have an indication of their type. Also the
G-codes could be displayed along with the corresponding
CDTL information. This would make it quite easy to review
the current "menu" and either add more programs or cancel
15 programs as desired.

A television calendar 200 according to this invention
is illustrated in FIG. 8. As shown, the television
calendar has multiple day of year sections 202, multiple
day sections 204, multiple time of day sections 206,
20 channel identifiers 208, and descriptive program
identifiers 210, including the name of the program,
arranged in a manner that is common in television guide
publications. Arranged in relation to each channel
identifier is a compressed code indication 212 or G-code
25 containing the channel, date, time and length information
for that entry in the television calendar. FIG. 8 shows
how easy it is to perform timer programming. All one
needs to do is find the program one wants to watch and
enter the compressed code shown in the compressed code
30 indication. This is in contrast to having to deal with
all the channel, date, time and length entries separately.
At least the channel, date and time are explicitly stated
in the television guide. The length is usually only
available by searching the guide to find the time of day
35 section 206 where a new program begins and then performing
some arithmetic to find the length of the program. Using
the compressed G-code avoids all these complications.

1 For cable television programs, there is an additional
issue that needs to be addressed for the compressed G-code
to be useful. In a normal television guide, CDTL
5 information is available for all the normal broadcast
channels in the form of numbers including the channel
numbers, such as channel 4 or 7. However, for cable
channels like HBO, ESPN etc., only the names of the
channels are provided in most television listings. The
reason for this is that in some metropolitan areas, such
10 as Los Angeles, there may be only one (1) edition of
television guide, but there may be quite a few cable
carriers, each of which may assign HBO or ESPN to
different cable channel numbers. In order for a
compressed code such as the G-code to be applicable to the
15 cable channels as published by a wide area television
guide publication, the following approach can be used.

 First, all the cable channels would be permanently
assigned a unique number, which would be valid across the
nation. For example, we could assign ESPN to cable
20 channel 1, HBO as cable channel 2, SHO as cable channel 3,
etc. This assignment would be published by the television
guide publications.

 The video cassette recorder apparatus, such as the
remote controller, the VCR unit or both, could then be
25 provided with two (2) extra modes: "set" and "cable
channel". One way of providing the user interface to
these modes would be to provide two (2) extra buttons: one
called SET and one called CABLE CHANNEL. The button
could be located on the video cassette recorder unit
30 itself or located on a remote controller, as shown in FIGS
1, 3 and 5, where SET is element 168 and CABLE CHANNEL is
element 170. Of course, other user interfaces are
possible.

 Next, the television viewer would have to go through
35 a one-time "setting" procedure of his VCR for all the
cable channels that he would likely watch. This "setting"
procedure would relate each of the assigned numbers for

1 each cable channel to the channel number of the local
cable carrier. For example, suppose that the local cable
carrier uses channel 6 for ESPN, then cable channel
number 1 could be assigned to ESPN, as shown in the
5 following table.

| | <u>Cable Channel</u> | <u>Assigned</u> | <u>Channel Number in</u> |
|----|----------------------|------------------------|--------------------------------|
| | <u>Name</u> | <u>Cable Chan. No.</u> | <u>the local cable carrier</u> |
| | ESPN | 1 | 6 |
| 10 | HBO | 2 | 24 |
| | SHO | 3 | 23 |
| | . | . | . |
| | . | . | . |
| | . | . | . |
| 15 | DIS | 8 | 25 |

The user could perform the "setting" procedure by pushing
the buttons on his remote controller as follows:

20 SET 06 CABLE CHANNEL 1 PROGRAM
SET 24 CABLE CHANNEL 2 PROGRAM
SET 23 CABLE CHANNEL 3 PROGRAM
SET 25 CABLE CHANNEL 8 PROGRAM

25 The "setting" procedure would create a cable channel
address table 162, which would be loaded into RAM 52 of
command controller 36. For the above example, the cable

30

35

1 channel address table 162 would have the following
information.

CABLE CHANNEL ADDRESS TABLE 162

| | | |
|----|---|----|
| 5 | 1 | 6 |
| | 2 | 24 |
| | 3 | 23 |
| | . | |
| | . | |
| 10 | . | |
| | 8 | 25 |

After the "setting" procedure is performed, the TV
viewer can now select cable channels for viewing by the
15 old way: eg. pushing the key pad buttons 24 will select
HBO. He can also do it the new way: eg. by pushing CABLE
CHANNEL 2, which will also select HBO. The advantage of
the new way is that the television guide will publish [C2]
next to the program description, so the viewer will just
20 look up the assigned channel number identifier instead of
having to remember that HBO is local cable channel 24.
When the CABLE CHANNEL button is pushed, command
controller 36 knows that it will look up the local cable
channel number in cable channel address table 162 to tune
25 the VCR to the correct channel.

For timer preprogramming and for using the compressed
G-code, a way to differentiate between broadcast and cable
channels is to add an eighth channel bit, which would be
set to 0 for normal broadcast channels and 1 for cable
30 channels such as HBO. This eighth channel bit could be
one of the low order bits such as the third bit C, out of
the eight channel bits, so that the number of bits to
specify popular channels is minimized, whether they be
normal broadcast or cable channels. For a normal
35 broadcast channel, the 7 other bits can be decoded
according to priority vector C table 124. For a cable

1 channel, the 7 other bits can be decoded according to a
separate cable channel priority vector table 160, which
could be stored in ROM 54 of microcontroller 36. The
cable channel priority vector table can be set ahead of
5 time for the entire country or at least for an area
covered by a particular wide area television guide
publication.

A television guide that carries the compressed code
known as the G-code will now print the cable channel
10 information as follows:

```
6:30 pm
[C2] HBO xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx (4679)
      xxxxxx(program description)xxxxxxxxxx
15      xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

The [C2] in front of HBO reminds the viewer that he needs
only to push CABLE CHANNEL 2 to select HBO. The (4679) is
the G-code indication for this particular program.

20 FIG. 8 shows a section of a television guide. The
cable channels all have an assigned cable channel number
188 in front of the cable channel mnemonic. Other than
that the cable channel information is arranged the same as
the broadcast channels with a compressed G-code 212
25 associated with the channel.

For timer preprogramming, the viewer need only enter
the number 4679 according to the unit's G-code entry
procedure, eg. PROG 4679 PROG. The G-code decoder unit
will decode this G-code into "cable channel 2" and will
30 also signal the command controller 36 with a cable channel
signal 164, as shown in FIGs. 1 and 2, because the extra
channel bit will be "1" which distinguishes that the
G-code is for a cable channel; then, since the association
of "cable channel 2" with channel 24 has been established
35 earlier in the "setting" procedure, the command
controller, if it has received a cable channel signal,
will immediately look up 2 in the cable channel address

1 table 162 to translate it to cable channel 24, which will
be used as the recording channel at the appropriate time.
By associating the G-code with the assigned cable channel
number rather than the local cable channel number, the
5 G-code for that program will be valid in the whole local
area, which may have many different cable carriers each of
which may have different local cable channel numbers.

To include the cable channel compressed G-code
feature, the decoding and encoding algorithms are as shown
10 in FIGs 9 and 10, respectively. The encoding should be
explained first before the decoding. The primary change
in FIG. 10 from FIG. 7 is that a cable channel priority
vector table 160 has been added and is used in look up
priority step 180 if a cable channel is being encoded.
15 Also if a cable channel is being encoded then the cable
channel bit is added in the correct bit position in the
convert C, D, T, L , to binary numbers step 182. This could be
bit C_3 , as discussed before. The bit hierarchy key could
be determined as before to compress the number of bits in
20 the most popular programs; however, it needs to be 23 bits
long to accommodate the cable channel bit. The maximum
compressed G-code length could still be 7 digits, because
 $2^3 = 8,388,608$.

The decoding is shown in FIG. 9 and is just the
25 reverse of the encoding process. After step 108, test
cable channel bit 174 is added and effectively tests the
cable channel bit to determine if it is a "1". If so then
the command controller 36 is signaled via cable channel
signal 164 of FIGs. 1 and 2 that the CDTL 118 that will be
30 sent to it from G-code decoder 38 is for a cable channel.
Then the command controller knows to look up the local
cable carrier channel number based on the assigned cable
channel number. In step 176 of FIG. 9, the priority
vector tables including the cable channel priority vector
35 table 160 are used to look up the CDTL 118 information.

1 An alternate to having the command controller receive
a cable channel signal 164 is for the G-code decoder to
perform all of the decoding including the conversion from
assigned cable channel number to local cable carrier
5 number. This would be the case for the remote controller
implementation of FIG. 3. FIG. 11 shows the
implementation of the entire decode algorithm if this step
is included. All that needs to be added is convert
assigned channel to local cable carrier channel step 166,
10 which performs a look up in cable channel address table
162, if the cable channel bit indicates that a cable
channel is involved. Step 166 effectively replaces step
174 in FIG. 9.

15 Another issue that needs addressing is the number of
programs that can be preprogrammed. Since the G-code
greatly simplifies the process of entering programs, it is
likely that the user will quickly learn and want to enter
a large number of programs; however, some existing VCRs
can only store up to four (4) programs, while some can
20 store as many as eight. Thus, the user may get easily
frustrated by the programming limitations of the VCR.

One approach to this problem, is to perform the
compressed G-code decoding in the remote controller and
provide enough memory there to store a large number of
25 programs, eg. 20 or 40. The remote controller would have
the capability of transferring periodically several of
these stored programs at a time to the VCR main unit. To
provide this capability, extra memory called stack memory
76 is required inside the remote unit, as shown in FIG.
30 12, which other than that is identical to FIG. 4. Stack
memory 76 can be implemented with a random access memory,
which may in fact reside in the microcontroller itself,
such as RAM 62.

35 The stack memory 76 is where new entry, insertion &
deletion of timer preprogramming information is carried
out. It is also where editing takes place. The top
memory locations of the stack, for example the first 4

1 locations, correspond exactly to the available timer
preprogramming memory in the VCR main unit. Whenever the
top of the stack memory is changed, the new information
will be sent over to the VCR main unit to update it.

5 FIG. 13 shows the sequence of events when the user
enters a G-code program on the keypad of the remote
controller. For illustration purposes, suppose the VCR
main unit can only handle four (4) programs. Suppose also
that the stack memory capacity is 20 timer preprograms.
10 Referring to the flow chart in FIG.13, when the user
enters a G-code in step 230, the microcontroller 60 first
decodes it into the CDTL information in step 234 and
displays it on the display unit with the additional word
"entered" also displayed. The microcontroller then enters
15 the decoded program into the stack memory in step 236.

If this is the first program entered, it is placed at
the top location of the stack memory. If there are
already programs in the stack memory, the newly entered
program will first be provisionally placed at the bottom
20 of the stack memory. The stack memory will then be sorted
into the correct temporal order in step 240, so that the
earliest program in time will appear in the top location
and the last program in time will be at the bottom.
Notice that the nature of the temporally sorted stack
25 memory is such that if stack memory location n is altered,
then all the locations below it will be altered.

For example, suppose the stack memory has six (6)
entries already temporally ordered, and a new entry is
entered whose temporal ordering places it in location 3 (1
30 being the top location). If this entry is placed into
location 3, information which was in location 3, 4, 5, 6
will be shifted to locations 4, 5, 6, and 7. Locations 1
and 2 will remain unchanged.

The microcontroller 60, after doing the temporal
35 ordering, checks in step 242 whether the first n entries
have changed from before, where for the current example n
equals 4. In this case, since a new program has been

1 entered into location 3, what used to be in location 3 now
moves to location 4. Since the VCR's main unit program
menu of 4 entries should correspond exactly to location 1
through 4 of the stack memory, entries 3 and 4 on the VCR
5 main unit must now be revised. The microcontroller
therefore sends out the new entries 3 & 4 to the main
unit, in step 244 of FIG. 13. If the newly entered
program, after temporal ordering, gets entered into
location 5, then entries 1 through 4 have not changed from
10 before and the microcontroller will not send any message
to the VCR main unit and the microcontroller will just
resume monitoring the clock 85 and the keyboard 88 as per
step 246. It is assumed that when the user enters the
G-code in step 230, the remote controller is pointed at
15 the VCR main unit. The other steps of FIG. 13 happen so
fast that the changes are sent in step 244 while the
remote controller is still being pointed at the VCR main
unit. If the user decides to delete a program in step
232, the deletion is first carried out in the stack
20 memory. If the first 4 entries are affected, the
microcontroller will send the revised information over to
the VCR main unit. If the first 4 entries are not
affected, then again the remote controller unit will not
send anything. The deletion will only change the lower
25 part of the stack (lower meaning location 5 to 20). This
new information will be sent over to the VCR main unit at
the appropriate time.

In the meantime, the VCR main unit will be carryin
out its timer programming function, completing its timing
30 preprogramming entries one by one. By the time all 4
recording entries have been completed, the stack in the
remote must send some new entries over to "replenish" the
VCR main unit (if the stack has more than 4 entries).

The real time clock 85 in the remote controller unit
35 is monitored by the microcontroller to determine when the
programs in the main unit have been used up. Referring to
the flow chart in FIG. 14, the microcontroller

1 periodically checks the clock and the times for the
programs at the top of the stack in step 250 (say the
first 4 entries), which are identical to the VCR's main
unit's menu. If on one of the periodic checks, it is
5 determined that the recording of the main unit's menu is
complete, then if there are more entries in the stack,
which is tested in step 252, the display unit will be set
to a blinking mode or display a blinking message in step
258 to alert the user to send more programs. Next time
10 the user picks up the remote unit, the blinking will
remind him that the VCR main unit's program menu has been
completed and it is time to replenish the VCR main unit
with program entries stored in the remote. The user
simply picks up the remote and points it towards the VCR
15 main unit and presses "ENTER". This will "pop" the top of
the stack memory in step 260, i.e. pop all the entries in
the stack up by four locations. The microcontroller will
then send the new "top of the stack" (i.e. top 4 entries)
over to the VCR main unit in step 262. This process will
20 repeat until the whole stack has been emptied.

Another preferred embodiment of an apparatus for
using compressed codes for recorder preprogramming is the
instant programmer 300 of FIG. 15. The instant programmer
300 has number keys 302, which are numbered 0 through 9,
25 a CANCEL key 304, a REVIEW key 306, a WEEKLY key 308, a
ONCE key 310 and a DAILY (M-F) key 312, which are used to
program the instant programmer 300. A lid normally
covers other keys, which are used to setup the instant
programmer 300. When lid 314 is lifted, the following
30 keys are revealed: SAVE key 316, ENTER key 318, CLOCK key
320, CH key 322, ADD TIME key 324, VCR key 326, CABLE key
328, and TEST key 330. Other features of instant
programmer 300 shown on FIG. 15 are: liquid crystal
display 350 and red warning light emitting diode 332. The
35 front elevation view FIG. 16 of instant programmer 300
shows front infrared (IR) diode 340 mounted on the front
side 338. By placing instant programmer 300 in front of

1 the equipment to be programmed such as video cassette
recorder 370, cable box 372, and television 374, as shown
in FIG. 19, the front infrared (IR) diode 340 can transmit
signals to control program recording. An IR transparent
5 cover 336 covers additional IR transmission diodes, which
are explained below.

FIG. 18 shows a detail of the liquid crystal display
350. Certain text 354 is at various times visible on the
display and there is an entry area 356. Time bars 352 are
10 displayed at the bottom of the display and their function
is described below.

A companion element to the instant programmer 300 is
the mounting stand 360, shown in FIG. 17, which is
designed to hold instant programmer 300 between left
15 raised side 362 and right raised side 364. The instant
programmer 300 is slid between left raised side 362 and
right raised side 364 until coming to a stop at front
alignment flange 365, which is at the front of mounting
stand 360 and connected across left raised side 362 and
20 right raised side 364, as shown in FIG. 17A. Together
elements 362, 364 and 365 provide alignment for instant
programmer 300 so that IR transparent cover 336 and the IR
diodes 342, 344, 346 and 348, shown in FIG. 17 are
properly aligned for transmission, when the instant
25 programmer is used as shown in FIG. 20. The mounting
stand 360 has an alignment flange 366, which has the
purpose of aligning the back edge of mounting stand 360,
which is defined as the edge along which alignment flange
366 is located, along the front side of a cable box or
30 VCR, or similar unit as shown in FIG. 20. When aligned as
shown in FIG. 20, the mounting stand 360 aligns the
instant programmer 300 so that the left IR diode 342, down
IR diode 344, two back IR diodes 346 and right IR diode
348, as shown in FIG. 17, are in position to transmit
35 signals to video cassette recorder 370 and cable box 372,
as necessary. If the VCR and/or cable box functions are
located within the television 374 itself, then the instant

1 programmer 300 could be positioned to transmit to the
television 374, either in the manner of FIG. 19 or by
placing the mounting stand on top of the television in the
manner of FIG. 20.

5 By using mounting stand 360, the user only need to
align the mounting stand 360, and the instant programmer
300 once with the equipment to be programmed rather than
having the user remember to keep the instant programmer
300 in the correct location to transmit via front infrared
10 (IR) diode 340, as shown in FIG. 19. Current experience
with various remote controllers shows that it is difficult
at best to keep a remote controller in a fixed location,
for example, on a coffee table. The mounting stand 360
solves this problem by locating the instant programmer 300
15 with the equipment to be controlled. The left IR diode
342, down IR diode 344, two back IR diodes 346 and right
IR diode 348 are positioned to transmit to the left,
downward, backward, and to the right. The downward
transmitter assumes that mounting stand 360 will be placed
20 on top of the unit to be programmed. The left and right
transmission allows units to the left or right to be
programmed. The backward transmission back IR diodes 346
are provided so that signals can bounce off walls and
other objects in the room. The front IR diode 340, the
25 left IR diode 342, the right IR diode 348 and the down IR
diode 344 are implemented with 25 degree emitting angle
diodes. Two back IR diodes are provided for greater
energy in that direction and are implemented with 5 degree
emitting angle diodes, which focus the energy and provide
30 for greater reflection of the IR energy off of walls or
objects in the room.

Most VCR's and cable boxes can be controlled by an
infrared remote controller; however, different VCR's and
cable boxes have different IR codes. Although there are
35 literally hundreds of different models of VCR's and cable
boxes, there are fortunately only tens of sets of IR
codes. Each set may have a few tens of "words" that

1 represent the different keys required, e.g. "power",
"record", "channel up", "channel down", "stop", "0", "1",
"2" etc. For the purpose of controlling the VCR and cable
5 box to do recording, only the following "words" are
required: "0", "1", "2", "3", "4", "5", "6", "7", "8",
"9", "power", "record", "stop". The IR codes for these
words for all the sets are stored in the memory of the
instant programmer 300, which is located in microcomputer
10 380 of FIGs. 21 and 22. During setup of the instant
programmer 300, the user interactively inputs to the
instant programmer 300 the type and model of his VCR and
cable box. The correct set of IR codes will be recalled
from memory during the actual control process. In the
15 case where the user only has a VCR, the infrared (IR)
codes for that particular VCR will be recalled to control
the VCR. In the case where the user has a VCR and a cable
box, the IR codes "power", "record", "stop" will be
recalled from the set that corresponds to the VCR whereas
20 the IR codes for "0" through "9" will be recalled from the
set that corresponds to the cable box. The reason is that
in this case, the cable box controls the channel
switching. Hence the channel switching signals "0"
through "9" must be sent to the cable box instead of the
VCR.

25 Initially, the user performs a setup sequence.
First, the user looks up the number corresponding to the
model/brand of VCR to be programmed in a table, which
lists the VCR brand name and a two digit code. Then with
the VCR tuned to Channel 3 or Channel 4, whichever is
30 normally used, the user turns the VCR "OFF". Then the
user presses the VCR key 326. When the display shows VCR,
the user presses the two-digit code looked up in the VCR
model/brand table (for example 01 for RCA). The user
points the instant programmer 300 at the VCR and then
35 presses ENTER key 318. The red warning light emitting
diode 332 will flash while it is sending a test signal to
the VCR. If the VCR turned "ON" and changed to Channel

1 09, the user presses the SAVE key 316 and proceeds to the
set clock step. If the VCR did not turn "ON" or turned
"ON" but did not change to Channel 09 the user presses
ENTER key 318 again and waits until red warning light
5 emitting diode 332 stops flashing. The instant programmer
300 sends the next possible VCR code, while the red
warning light emitting diode 332 is flashing. If the VCR
turns "ON" and changed to Channel 09 the user presses SAVE
key 316, otherwise the user presses ENTER key 318 again
10 until the VCR code is found that works for the VCR. The
display shows "END" if all possible VCR codes for that
brand are tried. If so, the user presses VCR key 326 code
00 and then ENTER key 318 to try all possible codes, for
all brands, one at a time.

15 Once the proper VCR code has been found and saved,
the next setup step is to set the clock on instant
programmer 300. First, the user presses the CLOCK key
320. When the display shows: "YR:", the user presses the
year (for example 90), then presses ENTER key 318. Then
20 the display shows "MO:", and the user presses the month
(for example 07 is July), and then presses ENTER key 318.
This is repeated for "DA:" date (for example 01 for the
1st), "Hr:" hour (for example 02 for 2 o'clock), "Mn:"
minute (for example 05 for 5 minutes), and "AM/PM:" 1 for
25 AM or 2 for PM. After this sequence, the display will
show "SAVE" for a few seconds and then the display will
show the current time and date that have been entered. It
is no longer necessary for the user to set the clock of
his/her VCR.

30 Next, if the instant programmer 300 is also to be
used as a cable box controller, then the setup steps are
as follows. First, the number corresponding to the
model/brand of cable box (converter) to be controlled is
looked up in a cable box model brand table, that lists
35 cable box brands and corresponding two digit codes. The
VCR is tuned to Channel 03 or 04 and turned "OFF". Then
the cable box is tuned to Channel 02 or 03, whichever is

1 normal, and left "ON". Then the CABLE key 328 is pressed.
When the display shows: "CA B-:" the user enters the two
digit code looked up in cable box model brand table,
points the instant programmer 300 at the cable box
5 (converter) and presses ENTER key 318. The red warning
light emitting diode 332 will flash while it is sending a
test signal to the cable box. If the cable box changed to
Channel 09: then the user presses SAVE key 316; however,
if the cable box did not change to Channel 09 the user
10 presses ENTER key 318 again and waits until red warning
light emitting diode 332 stops flashing, while the next
possible code is sent. This is repeated until the cable
box changes to Channel 09 and when it does the user
presses SAVE key 316. If the display shows "END" then the
15 user has tried all possible cable box codes for that
brand. If so, the user presses cable code 00 and then
ENTER key 318 to try all possible brand's codes, one at a
time.

For some people (probably because they have cable or
20 satellite), the channels listed in their television guide
or calendar are different from the channels on their
television or cable. If they are different, the user
proceeds as follows. First, the user presses the CH key
322. The display will look like this: "Guide CH TV CH".
25 Then the user presses the channel printed in the
television guide or calendar (for example, press 02 for
channel 2), and then the user presses the channel number
that the printed channel is received on through his/her
local cable company. Then the user presses ENTER key 318.
30 This is repeated for each channel listing that is on a
different channel than the printed channel. When this
procedure is finished the user presses SAVE key 316.

Typically the television guide or calendar in the
area will have a chart indicating the channel number that
35 has been assigned to each Cable and broadcast channel, for
example: HBO, CNN, ABC, CBS, NBC, etc. This chart would
correspond, for example, to the left two columns of FIG.

1 28. For example, suppose the television guide or calendar
has assigned channel 14 to HBO but the user's cable
company delivers HBO on channel 18. Since the channel
numbers are different, the user needs to use the CH key
5 322. The user will press the CH button (the two blank
spaces under the display "Guide CH" will flash). The user
then presses 14. (now the two blank spaces under the
display "TV CH" will flash). The user then presses 18 and
then ENTER key 318. This is repeated for each channel
10 that is different. When finished, the user presses SAVE
key 316.

After the channel settings have been saved, the user
may review the settings by pressing CH key 322 and then
REVIEW key 306. By repeated pressing of the REVIEW key
15 306 each of the set channels will scroll onto the display,
one at a time.

Then the user can test to make sure that the location
of the instant programmer 300 is a good one. First, the
user makes sure that the VCR is turned "OFF" but plugged
20 in and makes sure that the cable box (if there is one) is
left "ON". Then the user can press the TEST key 330. If
there is only a VCR, then if the VCR turned "ON", changed
to channel 09 and started recording, and then turned
"OFF", then the VCR controller is located in a good place.

25 If there is also a cable box, then if the VCR turned
"ON", the cable box turned to channel 09 and the VCR
started recording, and then the VCR stopped and turned
"OFF", then the instant programmer 300 is located in
good place.

30 To operate the instant programmer 300, the VCR should
be left OFF and the cable box ON. The user looks up in
the television guide the compressed code for the program,
which he/she wishes to record. The compressed code 212 is
listed in the television guide, as shown in FIG. 8. The
35 television guide/calendar that would be used with this
embodiment would have the same elements as shown on FIG.
8 except that element 188 of FIG. 8 is not required. The

1 compressed code 212 for the program selected by the user
is entered into the instant programmer 300 by using the
number keys 302 and then the user selects how often to
record the program. The user presses the ONCE key 310 to
5 record the program once at the scheduled time, or the user
presses the WEEKLY key 308 to record the program every
week at the same scheduled time until cancelled or the
user presses the DAILY (M-F) key 312 to record the program
each day Monday through Friday at the same scheduled time
10 until cancelled. This is most useful for programs such as
soapbox operas that air daily, but not on the weekend. To
confirm the entry, the instant programmer 300 will
immediately decode the compressed code and display the
date, channel and start time of the program entered by the
15 user. The length of the entered program is also displayed
by time bars 352 that run across the bottom of the
display. Each bar represents one hour (or less) of
program.

20 Then the user just needs to leave the instant
programmer 300 near the VCR and cable box so that commands
can be transmitted, and at the right time, the instant
programmer 300 will turn "ON" the VCR, change to the
correct channel and record the program and then turn the
VCR "OFF". The user must just make sure to insert a blank
25 tape.

The REVIEW key 306 allows the user to step through
the entered programs. These are displayed in
chronological order, by date and time. Each time the
REVIEW key 306 is pressed, the next program is displayed,
30 until "END" is displayed, when all the entered programs
have been displayed. If the REVIEW key 306 is pressed
again the display will return to the current date and
time.

35 If the user wishes to cancel a program, then the user
presses REVIEW key 306 until the program to cancel is
displayed, then the user presses CANCEL key 304. The
display will say "CANCELLED". Also, any time the user

1 presses a wrong number, pressing the CANCEL key 304 will
allow the user to start over.

Certain television programs, such as live sports, may
run over the scheduled time slot. To ensure that the
5 entire program is recorded, the user may press the ADD
TIME key 324 to increase the recording length, even while
the program is being recorded. The user presses the
REVIEW key 306 to display the program, then presses ADD
TIME key 324. Each time ADD TIME key 324 is pressed, 15
10 minutes is added to the recording length.

When the current time and date is displayed, the
amount of blank tape needed for the next 24 hours is also
displayed by the time bars 352 that run across the bottom
of the display. Each bar represents one hour (or less) of
15 tape. The user should check this before leaving the VCR
unattended to ensure that there is enough blank tape.

Each time a program code is entered, the instant
programmer 300 automatically checks through all the
entries to ensure that there is no overlap in time between
20 the program entries. If the user attempts to enter a
program that overlaps in time with a program previously
entered, then the message "CLASH" appears. Then, as
summarized by step 432 of FIG. 23, the user has the
following options: 1) if the user wishes to leave the
25 program previously entered and forget about the new one,
the user does nothing and after a short time delay, the
display will return to show the current time and date; 2)
if the user wishes the program which starts first to be
recorded to its end, and then to record the remainder of
30 the second program, then the user presses ONCE key 310,
DAILY (M-F) key 312, or WEEKLY key 308 again (whichever
one the user pushed to enter the code). If the programs
have the same starting time, then the program most
recently entered will be recorded first. If on being
35 notified of the "CLASH", the user decides the new program
is more important than the previously entered program,

1 then the user can cancel the previously entered program
and then re-enter the new one.

5 In some locations, such as in some parts of Colorado,
the cable system airs some channels three (3) hours
later/earlier than the times listed in the local
television guide. This is due to time differences
depending on whether the channel is received on a east or
west satellite feed. For the user to record the program
3 hours later than the time listed in the television guide
10 the procedure is as follows. First the user enters the
code for the program and then presses SAVE key 316 (for +)
and then presses ONCE key 310, DAILY (M-F) key 312, or
WEEKLY key 308, as desired. For the user to record the
program 3 hours earlier than the time listed in the
15 television guide the procedure is as follows. First the
user enters the code for the program and then presses
ENTER key 318 (for -) and then presses ONCE key 310, DAILY
(M-F) key 312, or WEEKLY key 308, as desired. The instant
programmer 300 will display the time that the program will
20 be recorded, not the time shown in the television guide.

There are certain display messages to make the
instant programmer 300 more user friendly. The display
"LO BATT" indicates that the batteries need replacement.
"Err: ENTRY" indicates an invalid entry during set up.
25 "Err: CODE" indicates that the program code number entered
is not a valid number. If this is displayed the user
should check the television guide and reenter the number.
"Err: DATE" indicates the user may have: tried to select
a daily recording (Monday to Friday) for a Saturday or
30 Sunday program; tried to select weekly or daily recording
for a show more than 7 days ahead, because the instant
programmer 300 only allows the weekly or daily recording
option to be used for the current weeks' programs (± 7
days); or tried to enter a program that has already ended.
35 "FULL" indicates that the stack storage of the programs to
be recorded, which is implemented in random access memory
(RAM) inside the instant programmer 300 has been filled.

1 The user could then cancel one or more programs before
entering new programs. "EMPTY" indicates there are no
programs entered to be recorded. The number of programs
to be recorded that can be stored in the instant
5 programmer 300 varies depending on the density of RAM
available and can vary from 10 to more.

FIG. 21 is a schematic of the circuitry needed to
implement the instant programmer 300. The circuitry
consists of microcomputer 380, oscillator 382, liquid
10 crystal display 384, key pad 386, five way IR transmitters
390 and red warning light emitting diode 332. The
microcomputer 380 consists of a CPU, ROM, RAM, I/O ports,
timers, counters and clock. The ROM is used for program
storage and the RAM is used among other purposes for stack
15 storage of the programs to be recorded. The liquid
crystal display 384 is display 350 of FIGs. 15 and 18.
The key pad 386 implements all the previously discussed
keys. The five way IR transmitters 390 consists of front
infrared (IR) diode 340, left IR diode 342, down IR diode
20 344, two back IR diodes 346 and right IR diode 348. FIG.
22 shows the detailed schematic of the instant programmer
300 circuitry and previously identified elements are
identified by the same numbers. The microcomputer can be
implemented with a NEC μ PD7530x part, which can interface
25 directly with the display, the keypad, the light emitting
diodes and the oscillator. The 25 degree IR diodes can be
implemented with NEC 313AC parts and the 5 degree IR
diodes can be implement with Litton 2871C IR diodes.

The flow charts for the program that is stored in the
30 read only memory (ROM) of the microcomputer 380 that
executes program entry, review and program cancellation,
and record execution are illustrated in FIGs. 23, 24, and
25, respectively. The FIG. 23 for program entry, which
process was described above, consists of the following
35 steps: display current date, time and time bars step 402,
which is the quiescent state of instant programmer 300;
scan keyboard to determine if numeric decimal compressed

1 code entered step 404; display code as it is entered step
406; user checks if correct code entered step 408 and user
presses CANCEL key 304 step 428; user advances or retards
start time by three hours by pressing SAVE key 316 or
5 ENTER key 318 step 410; user presses ONCE key 310, WEEKLY
key 308 or DAILY key 312 key step 412; microcomputer
decodes compressed code into CDTL step 414; test if
conflict with stored programs step 416, if so, display
"CLASH" message step 420, user presses ONCE key 310,
10 WEEKLY key 308 or DAILY key 312 step 422, then accommodate
conflicting entries step 432, as described above in the
discussion of the "CLASH" options, and entry not saved
step 424; set display as date, channel, start time and
duration (time bars) for ONCE, or DA, channel, start time
15 and duration for DAILY, or day of week, channel, start
time and duration for WEEKLY step 418; user presses ADD
TIME key 324, which adds 15 minutes to record time step
426; user checks display step 430; enter program on stack
in chronological order step 434 wherein the stack is a
20 portion of the RAM of microcontroller 380; and calculate
length of tape required and update time bars step 436.

The FIG. 24 flowchart for review and cancellation,
which process was described above, consists of the
following steps: display current date, time and time bars
25 step 402; REVIEW key 306 pressed step 442; test if stack
empty step 444, display "EMPTY" step 446, and return to
current date and time display step 448; display top stack
entry step 450; user presses ADD TIME key 324 step 452 and
update time bars step 460; user presses REVIEW key 306
30 step 454 and scroll stack up one entry step 462; user
presses CANCEL key 304 step 456 and display "CANCELLED"
and cancel program step 464; and user does nothing step
458 and wait 30 seconds step 466, wherein the 30 second
timeout can be implemented in the timers of microcomputer
35 380.

The FIG. 25 flowchart for record execution, which is
the process of automatically recording a program and which

1 was described above, consists of the following steps:
compare start time of top program in stack memory with
current time step 472; test if three minutes before start
time of program step 474; start red warning LED 332
5 blinking for 30 seconds step 476; display channel, start
time and blinking "START" message step 478, is correct
start time reached step 480 and send power ON signal to
VCR and display "REC" message step 482; test if a cable
box is input to VCR step 484, send channel switching
10 signals to VCR step 486 and send channel switching signals
to cable box step 488; send record signals to VCR step
490; compare stop time with current time step 492, test if
stop time reached step 494 and display "END" message step
496; send stop signals to VCR step 498; send power OFF
15 signal to VCR step 500; and pop program stack step 502.

FIG. 26 is a flowchart of the method for encoding
channel, date, time and length (CDTL) into decimal
compressed code 510. This process is done "off-line" and
can be implemented on a general purpose computer and is
20 done to obtain the compressed codes 212 that are included
in the program guide or calendar of FIG. 8. The first
step in the encoding method is the enter channel, date,
time and length (CDTL) step 512 wherein for a particular
program the channel, date, start time and length CDTL 514
25 of the program are entered. The next step is the look up
assigned channel number step 516, which substitutes an
assigned channel number 522 for each channel 518. Often,
for example for network broadcast channels, such as
channel 2, the assigned channel number is the same;
30 however, for a cable channel such as HBO a channel number
is assigned and is looked up in a cable assigned channel
table 520, which would essentially be the same as the
first two columns of the table of FIG. 28. Next, the look
up priority of channel, date and time/length in priority
35 vector tables step 524 performs a look up in priority
vector channel (C) table 526, priority vector date (D)
table 528 and priority vector time/length (TL) table 530

1 using the indices of channel, date and time/length,
respectively, to produce the vector C, D, TL, 532. The
use of a combined time/length (TL) table to set priorities
recognizes that there is a direct relationship between
5 these combinations and the popularity of a program. For
example, at 6:30 PM, a short program is more likely to be
popular than a 2 hour program, because it may be the
dinner hour.

The channel priority table is ordered so that the
10 most frequently used channels have a low priority number.
An example of the data that is in the priority vector C
table 526 follows.

| | | | | | | | | | | |
|----|----------|---|---|---|---|---|---|----|----|-----|
| 15 | channel | 4 | 7 | 2 | 3 | 5 | 6 | 11 | 13 | ... |
| | priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

Generally the dates of a month all have an equal
priority or equal usage, so the low number days in a month
and the low number priorities would correspond in the
20 priority vector D table 528 as in the following example.

| | | | | | | | | | | |
|--|----------|---|---|---|---|---|---|---|---|-----|
| | date | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ... |
| | priority | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | ... |

25 The priority of the start times and length of the
programs could be arranged in a matrix that would assign
a priority to each combination of start times and program
lengths so that more popular combinations of start time
and length would have a low priority number and less
30 popular combinations would have a high priority number.

1 For example, a partial priority vector T/L table 530 might appear as follows.

| Priority TL Table | | | | | |
|-------------------|--------------|--------|--------|--------|------------|
| | TIME | 6:30pm | 7:00pm | 7:30pm | 8:00pm ... |
| 5 | Length (hrs) | | | | |
| | .5 | 8 | 4 | 7 | 10 |
| | 1.0 | 12 | 15 | 13 | 18 |
| | 1.5 | 20 | 19 | 17 | 30 |

10 Suppose the channel, date, time and length (CDTL) 514 data is channel 5, February 10, 1990, 7:00PM and 1.5 hours in length, then the C_p, D_p, TL_p data 532 for the above example would be 4 9 19. The next step is the convert C_p, D_p, TL_p to binary numbers and concatenate them into one binary number step 534, resulting in the data word ... $TL_p TL_p ... C_p C_p ... D_p D_p$ 536. For the example given above, converting the ... $TL_p TL_p ... C_p C_p ... D_p D_p$ 536 word to binary would yield the three binary numbers: ...0010011, ...0100, ...01001. The number of binary bits to use in each conversion is determined by the number of combinations involved. This could vary depending on the implementation; however one preferred embodiment would use eight bits for C_p , denoted as $C_1 C_2 C_3 C_4 C_5 C_6 C_7 C_8$, which would provide for 256 channels, five bits for D_p , which can be denoted as $D_1 D_2 D_3 D_4 D_5$, would provide for 31 days in a month, and fourteen bits for TL_p , denoted as $TL_{p1} ... TL_{p14}$, which would provide for start times spaced every 5 minutes over 24 hours and program lengths in increments of 5 minute lengths for programs up to 3 hours in length and program length in increments of 15 minute lengths for programs from 3 to 8 hours in length. This requires about $288 * (36 + 20) = 16,128$ combinations, which are provided by the $2^{14} = 16,384$ binary combinations. Altogether there are $8 + 5 + 14 = 27$ bits of information

35 $TL_{p1} ... TL_{p14} C_{p1} ... C_{p8} D_{p1} ... D_{p5}$. For the above example padding each number with zeros and then concatenating them would

1 yield the 27 bit binary number:
000000000100110000010001001.

5 The next step is to use bit hierarchy key 540, which
can be stored in read only memory 64 to perform the
reorder bits of binary number according to bit hierarchy
key step 538. As described previously, a bit hierarchy
key 540 can be any ordering of the ...TL₁TL₁...C₁C₁...D₁D₁
536 bits and in general will be selected so that programs
most likely to be the subject of timer preprogramming
10 would have a low value compressed code 212, which would
minimize keystrokes. The ordering of the bit hierarchy
key can be determined by the differential probabilities of
the various bit combinations as previously discussed. The
details of deriving a bit hierarchy key 540 were described
15 relative to bit hierarchy key 120 and the same method can
be used for bit hierarchy key 540. For example, the bit
hierarchy key might be:

20 TL₁ C₁ ... TL₁₀ C₂ TL₁ C₁ L₁ D₁ D₄ D₃ D₂ D₁
27 26 ... 10 9 8 7 6 5 4 3 2 1

The next step is the combine groups of bits and
convert each group into decimal numbers and concatenate
into one decimal number step 542. For example, after
25 reordering according to the bit hierarchy key, the code
may be 000000001010010000010001001, which could be grouped
as 00000000101001000,0010001001. If these groups of
binary bits are converted to decimal as 328,137 and
30 concatenated into one decimal number, then the resulting
decimal number is 328137. The last encoding step is the
permute decimal number step 546, which permutes the
decimal number according to permutation function 544 that
is dependent on the date 548 and in particular the month
and year and provides a security feature for the codes.
35 After the permute decimal number step 546, the decimal
compressed code G₁...G₂G₁ 550 may, for example, be 238731.

1 These encoded codes are then included in a program guide
or calendar as in the compressed code indication 212 of
FIG. 8.

5 FIG. 27 is a flowchart of the method for decoding a
decimal compressed code into channel, date, time and
length 560, which is step 414 of FIG. 23. Once the
decimal compressed code $G_1 \dots G_n$, 564 is entered in step
562, it is necessary to invert the permutation function of
steps 544 and 546 of FIG. 26. The first step is the
10 extract day code step 566, which extracts the day code for
the program in the decimal compressed code and passes the
day code to step 568, which also receives the current day
574 from the clock 576, which is implemented by
microcomputer 380 in FIGs. 21 and 22. The clock 576 also
15 sends the current month and year to the permutation
function 570, which is dependent on the month and year.
Then step 568 performs the function: if day code is same
or greater than current day from clock, then use
permutation function for month/year on clock, otherwise
20 use permutation function for next month after the month on
the clock and use next year if the month on the clock is
December. In other words, since there is provision for
preprogramming recording for one month or 31 days ahead,
if the day for the program is equal to or greater than the
25 current day of the month, then it refers to a day in the
present month; otherwise, if the day for the program is
less than the current day of the month, it must refer to
a program in the next month. The extract day code step
566, which must be performed before the invert permutation
30 of decimal compressed code step 580, is accomplished by a
prior knowledge of how the permute decimal number step 546
of FIG. 26 is performed relative to the day code
information.

35 The selected permutation method 578 is used in the
invert permutation of decimal compressed code step 580.
For the example given above, the output of step 580 would

1 be: 328137. The next step is the convert groups of
decimal numbers into groups of binary numbers and
concatenate binary groups into one binary number step 584,
which is the inverse of step 542 of FIG. 26 and for the
5 above example would result in the binary code:
000000001010010000010001001. Then the bit hierarchy key
588 is used in the reorder bits of binary number according
to bit hierarchy key step 586, which inverts step 538 of
FIG. 26 to obtain 000000000100110000010001001 for the
10 above example, which is $\dots TL_2 TL_1 \dots C_2 C_1 \dots D_2 D_1$ 582
corresponding to 536 of FIG. 26. The next step is to
group bits to form three binary numbers TL_2 , C_2 , D_2 and
convert to decimal numbers step 590 resulting in C_2 , D_2 ,
 TL_2 592, which for the example above would be: 4, 9, 19,
15 and which are priority vectors for channel, day and
time/length, which in turn are used to look up channel,
day, time and length 604 in priority vector channel (C)
table 598, priority vector date (D) table 600, and
priority vector time/length (TL) table 602, respectively.
20 The look up local channel number step 606 looks up
the local channel 612 given the assigned channel number
608, in the assigned/local channel table 610, which is
setup by the user via the CH key 322, as explained above.
An example of the assigned/local channel table 610 is the
25 right two columns of the assigned/local channel table 620
of FIG. 28. The correspondence between the assigned
channel numbers, such as 624 and 628, and the local
channel numbers, such as 626 and 630 is established during
setup by the user. For the example, FIG. 28 shows an
30 exact correspondence between the assigned channel number
5 and the local channel number 5. The last step is the
append month and year to day to form date step 614. The
correct month and year are obtained from step 568 and are
again dependent on whether the day code is equal to or
35 greater than the day from the clock or less than the day
from the clock. If the day code is equal to or greater

1 than the day from the clock, the month and year as shown
on the clock are used, otherwise the next month is used
and the next year is used if the clock month is December.
The result is the channel, date, time and length (CDTL)
5 618, which for the above example would be channel 5,
February 10, 1990, 7:00PM and 1.5 hours in length.

Another preferred embodiment is to embed the decoding
means into a television receiver with G-code decoder 950,
as shown in FIG. 29, which is a block diagram of a system
10 including a television receiver having a G-code decoder.
The user would use the television remote controller 956 or
controls on the television receiver to enter the code that
signifies the program to be recorded. The same television
remote and controls on the television would also be used
15 to perform normal television control functions, such as
channel selection. When a G-code is entered, the
television remote would send the G-code to the television
with G-code decoder 950 via infrared transmitter 958. An
infrared receiver 960 on the television receiver 950 would
20 receive the transmission and send the code to the G-code
decoder 954, which would decode the code into CDTL and use
this information along with a clock, which would also be
embedded in the television receiver 950, to send the
proper commands to the VCR 964 and cable box 966 at the
25 appropriate time so that the selected program will be
recorded at the proper time. The transmission from the
television 950 would be via infrared transmitters 962,
which can be placed at strategic points on the television
cabinet, such as at the corners. The transmission is then
30 received by the VCR 964 via infrared receiver 968 and the
cable box 966 via infrared receiver 969.

FIG. 30 is a schematic of a television receiver
having a G-code decoder. The television receiver with
G-code decoder 950 would receive signals from the
35 television remote controller 956 via infrared receiver
960, which would send the signals to either command
controller 974 or directly to G-code decoder 954. The

1 command controller 974 may be present in the television
receiver to control other items in the television,
including "on screen" functions such as displaying the
channel number when the channel is changed. The G-code
5 decoder 954 would decode a sent G-code and using the date
and time from clock 976 would send the proper commands to
the VCR 964 and cable box 966 via infrared transmitters
962. The G-codes and other commands could also be sent to
the command controller via manual control 975. When the
10 G-code is decoded, then the G-code and the decoded CDTL
information could be displayed "on screen" as shown in on
screen display 978 on television display/monitor 952. The
"on screen" display is not necessary and any format is
optional.

15 FIG. 31 is a schematic showing apparatus for a G-code
decoder in a television receiver having G-code decoding.
The circuitry is very similar to that described in FIGs.
21 and 22; however, there are interfaces to an infrared
receiver 960 and command controller 974 rather than LCD
20 384 and Key Pad 386. The key elements are microcontroller
980 and oscillator 982. The interface to command
controller 974 is one preferred embodiment; another
embodiment could have direct interfaces between the manual
control 975, the infrared receiver 960, the television
25 display/monitor 952 and the G-code decoder 954 without
going through the intermediary command controller 974.
The television circuitry would include the capability of
storing or learning the infrared code protocols for the
VCR and the cable box. The warning light emitting diode
30 984 would be mounted on the cabinet of the television to
warn that recording was about to begin in order to alert
the user to have the VCR ready with tape to record.

With the "on screen" display on television
display/monitor 952, the operation of the television
35 receiver with G-code decoder 950 can be essentially
identical to that described in FIGs. 23, 24 and 25 for
program entry, program review and program cancellation,

1 and execution of recorder preprogramming using compressed
codes, respectively. Every that was displayed on LCD 384
would instead be displayed on the television monitor 952.
The only difference would be that "on screen" would only
5 perform step 402 (display current date, time and time
bars) when the user put television remote controller 956
into a mode for G-code entry and transmission, program
review or program cancellation. The method of encoding
program channel, date, time and length information into
10 decimal compressed codes of FIG. 26, the method of
decoding decimal compressed codes into program channel,
date, time and length information of FIG. 27, and the
method of assigning channel numbers to local channel
numbers as illustrated in FIG. 28 would stay the same.

15 Another preferred embodiment of the invention is to
embed the decoding means into various equipments
associated with television, such as a video cassette
recorder, cable box or satellite receiver. In any system
the decoding means would only have to be present in one of
20 the equipments, such as the cable box, which would then at
the appropriate time distribute the proper commands to the
other equipments such as a VCR and a satellite receiver to
record the desired program.

FIG. 32 is a block diagram of a system including a
25 television having a G-code decoder 950, a VCR 964, a cable
box 966 and a satellite receiver 986. This system would
work identically to the system shown in FIG. 29, except
that a satellite receiver is included, which could receive
commands via infrared receiver 988 from infrared
30 transmitters 962 mounted on television receiver with
G-code decoder 950. The commands received by the
satellite receiver could include on/off commands and
channel select commands. The satellite receiver 986 could
feed a television signal to VCR 964, which would record
35 the program and/or relay it to television display/monitor
952.

1 FIG. 33 is a block diagram of a system including a
VCR having a G-code decoder 991, a television 952, a cable
box 966 and a satellite receiver 986. The user would use
the television remote controller 956 or controls on the
5 VCR 991 to enter the code that signifies the program to be
recorded. When a G-code is entered, the television remote
would send the G-code to VCR 991 with G-code decoder 992
via infrared transmitter 958. An infrared receiver 990 on
the VCR 991 would receive the transmission and send the
10 code to the G-code decoder 992, which would decode the
code into CDTL and use this information along with a
clock, which would also be embedded in the VCR 991, to
send the proper commands to the cable box 966 and the
satellite receiver 986 at the appropriate time so that the
15 selected program will be recorded at the proper time. The
transmission from the VCR 991 would be via infrared
transmitters 994, which can be placed at strategic points
on the VCR. The transmission is then received by the
cable box 966 via infrared receiver 969 and the satellite
20 receiver 986 via infrared receiver 988.

Another preferred embodiment of the transmission
method and apparatus between equipments is shown in FIG.
36, which is a perspective view showing a cable box 372
placed on top of a VCR 370 having an infrared transmitter
1008 behind the front panel 1009 which communicates to the
25 cable box infrared receiver 1010 via reflection from
surrounding reflecting surfaces such as walls.

Another preferred embodiment of the transmission
method and apparatus between equipments is shown in FIG.
30 37, which is a perspective view showing a cable box 372
placed on top of a VCR 370 having an infrared transmitter
1014 inside a infrared dome 1012 on the top of the VCR
which communicates to the cable box infrared receiver 1010
via direct communication or reflection depending on
35 placement of the infrared receiver 1010 relative to
infrared dome 1012.

1 Another preferred embodiment of the transmission
method and apparatus between equipments is shown in FIG.
38, which is a perspective view of a VCR 370 having an
infrared transmitter 1022 inside a mouse 1020 coupled via
5 a cable 1018, which is plugged via plug 1017 into
receptacle 1016 on the VCR. The mouse 1020 is placed near
the cable box infrared receiver 1010. This embodiment is
most useful when the cable box is separated from the VCR
by walls of a cabinet, for example, that would prevent
10 either direct or reflective infrared transmission.

 Another preferred embodiment of the transmission
method and apparatus between equipments is shown in FIG.
39, which is a perspective view of a VCR 370 having an
infrared transmitter 1026 inside a stick on miniature
15 mouse 1024 coupled via a cable 1018, which is plugged via
plug 1017 into receptacle 1016 on the VCR. The stick on
miniature mouse 1024 is stuck onto the cable box very near
the infrared receiver 1010. This embodiment is also most
useful when the cable box is separated from the VCR by
20 walls of a cabinet, for example, that would prevent either
direct or reflective infrared transmission.

 The transmission methods and apparatus of FIGs. 36,
37, 38 and 39 could also be used with the system of FIG.
32 to transmit information from television receiver with
25 G-code decoder 950 to VCR 964, cable box 966 and satellite
receiver 986.

 FIG. 34 is a block diagram of a system including a
cable box having a G-code decoder 997, a television 952
a VCR 964, and a satellite receiver 986. The user would
30 use the television remote controller 956 or controls on
the cable box 997 to enter the code that signifies the
program to be recorded. When a G-code is entered, the
television remote would send the G-code to cable box 997
with G-code decoder 998 via infrared transmitter 958. An
35 infrared receiver 996 on the cable box 997 would receive
the transmission and send the code to the G-code decoder
998, which would decode the code into CDTL and use this

1 information along with a clock, which would also be
embedded in the cable box 997, to send the proper commands
to the VCR 964 and the satellite receiver 986 at the
appropriate time so that the selected program will be
5 recorded at the proper time. The transmission from the
cable box 997 would be via infrared transmitters 1000,
which can be placed at strategic points on the cable box.
The transmission is then received by the VCR 964 via
infrared receiver 968 and the satellite receiver 986 via
10 infrared receiver 988. The transmission methods and
apparatus of FIGs. 36, 37, 38 and 39 could also be used
with the system of FIG. 34 to transmit information from
cable box 997 to VCR 964 and satellite receiver 986.

FIG. 35 is a block diagram of a system including a
15 satellite receiver 1005 having a G-code decoder, a
television 952, a VCR 964, and a cable box 966. The user
would use the television remote controller 956 or controls
on the satellite receiver 1005 to enter the code that
signifies the program to be recorded. When a G-code is
20 entered, the television remote would send the G-code to
satellite receiver 1005 with G-code decoder 1004 via
infrared transmitter 958. An infrared receiver 1002 on
the satellite receiver 1005 would receive the transmission
and send the code to the G-code decoder 1004, which would
25 decode the code into CDTL and use this information along
with a clock, which would also be embedded in the
satellite receiver 1005, to send the proper commands to
the VCR 964 and the cable box 966 at the appropriate time
so that the selected program will be recorded at the
30 proper time. The transmission from the satellite receiver
1005 would be via infrared transmitters 1006, which can be
placed at strategic points on the satellite receiver. The
transmission is then received by the VCR 964 via infrared
receiver 968 and the cable box 966 via infrared receiver
35 969. The transmission methods and apparatus of FIGs. 36,
37, 38 and 39 could also be used with the system of FIG.

1 35 to transmit information from satellite receiver 1005 to
VCR 964 and cable box 966.

5 Another preferred embodiment of an apparatus for
using compressed codes for a recorder programming is the
custom programmer 1100 of FIGS. 40 and 41. The custom
programmer 1100 is similar to instant programmer 300 and
has number keys 1102, which are numbered 0-9, a CANCEL key
1104, a REVIEW key 1106, a WEEKLY key 1108, a ONCE key
1110 and a DAILY (M-F) key 1112, which correspond directly
10 to keys 302-312 of instant programmer 300, and which are
used to program the custom programmer 1100. Like the
instant programmer 300, a lid normally covers other keys,
which are used to set up the instant custom programmer
1100. When lid 1114 is lifted, the following keys are
15 revealed, but not shown in the drawings: SAVE key, ENTER
key, CLOCK key, CH key, ADD TIME key, VCR key, CABLE key,
and TEST key. These keys of the custom programmer 1100
correspond to and operate substantially the same as keys
316-330 of instant programmer 300, respectively. Also
20 included in the custom programmer 1100 shown in FIG. 40
are: liquid crystal display 1134, red warning light
emitting diode 1132 and IR diodes 1134, which correspond
to liquid crystal display 350, red warning light emitting
diode 332 and IR diodes 342-348 as shown in FIG. 15.

25 As discussed above, when using the instant programmer
300, the consumer initially performs a set-up sequence,
consisting of selecting a protocol for the model/brand of
VCR, setting the current real time, selecting a protocol
for the model/brand of cable box, and entering a series of
30 channel number assignments. Although the instant
programmer 300 makes recording of television programs
extremely simple, the initial set-up sequence for the
instant programmer 300 is more complex and deters the use
of the instant programmer by some consumers. Custom
35 programmer 1100 includes a microphone opening 1140 through
which at least one microphone inside the custom programmer
1100 can receive electronically coded audio signals that

1 contain the information necessary for the custom
programmer's initial set-up and commands to store this
information into the custom programmer 1100.

5 In order to receive these audio signals, a user may
call a special phone number which could be a toll-free 800
number, a pay-per-minute 900 number, or a standard
telephone number with standard toll charges applying. The
consumer can speak to an operator who orally inquires from
the consumer the information regarding the consumer's VCR
10 model and brand, zip code, model and brand of cable box
and the newspaper or other publication which the consumer
will use to obtain the compressed codes. This is all the
information needed to perform the initial set-up for the
custom programmer 1100. From the zip code information,
15 the operator can determine to which cable system the
consumer is connected and can combine this data with the
knowledge of which publication the consumer will use to
select the correct local channel mapping table for the
consumer.

20 The operator then directs the consumer to press a
designated programming key which is, in the case of the
preferred embodiment, the CH key located under lid 1114.
When the CH key is pressed, the display 1134 with display
the message "PHONE1 KEY2". Pressing the "2" numeric key
25 places the custom programmer into the manual local channel
table programming mode that is implemented by instant
programmer 300 when CH key 322 is pressed. Pressing the
"1" numeric key initiates the remote programming mode.
The custom programmer 1100 is then ready to receive an
30 audio signal and display 1134 displays the message "WAIT".

The operator will then direct the consumer to place
the earpiece 1142 of the telephone receiver 1144 over the
microphone opening 1140 of the custom programmer 1100 as
generally shown in FIG. 42. The earpiece need not be
35 placed directly against the custom programmer 1100, but
may be held more than an inch away from the microphone
opening with generally satisfactory results. After a pause

1 sufficient to allow the consumer to place the telephone
receiver in the proper position, the operator will
initiate the downloading of the initial set-up data and
initial set-up programming commands transmitted over the
5 telephone line 1146 using audio signals to the consumer's
custom programmer 1100.

If the initial set-up data is successfully
transferred to the custom programmer 1100, the display
1134 of the custom programmer 1100 will display the
10 message "DONE". If the reception of the initial set-up
data is not successful within a predetermined time limit,
red warning light emitting diode 1132 will blink to inform
the consumer to adjust the position of the telephone
earpiece before another down load of the information is
15 attempted. After a waiting period allowing this
adjustment, the initial set-up data and commands are
re-transmitted over the telephone line. If after a
predetermined number of attempts to download the initial
set-up information are unsuccessful, the liquid crystal
20 display 1134 displays the message "FAIL" and the operator
is again connected to the consumer allowing the operator
to speak to the consumer to provide additional assistance
in the positioning of the telephone earpiece.

Alternatively, a live operator could be provided by
25 the local cable company and the initial set-up information
downloaded to the custom programmer 1100 by telephone
line, through the existing cable of the cable system, or
any other transmission means. If local cable companies
supply the live operators, the only information they would
30 need to gather from the consumer would be the VCR brand
and model and the publication containing compressed codes
that the consumer plans on using, because the local cable
company would know the model and brand of cable box
installed at the consumer's location and the necessary
35 data regarding the local channel designations for that
cable system.

1 FIGS. 43 and 44 are schematics of the circuitry
needed to implement alternative embodiments of the custom
programmer 1100. The circuit consists of microcomputer
1150, oscillator 1152, liquid crystal display 1154, keypad
5 1156, five way IR transmitters 1158 and red warning light
emitting diode 1160. These components directly correspond
to microcomputer 380, oscillator 382, liquid crystal
display 384, keypad 386, five way IR transmitters 388 and
red warning light emitting diode 332, respectively of
10 instant programmer 300 and perform in the same manner. In
both FIGS. 43 and 44, earpiece 1142 generates serial audio
signals which are received by microphone 1162.

As shown in FIG. 43 the audio signals received by
microphone 1162 are passed through amplifier 1164 and
15 forwarded through a DTMF decoder circuit and into a serial
port of microcomputer 1150. In the alternative circuit
shown in FIG. 44, the audio signals received by microphone
1162 are passed through amplifier 1166, through a high
pass filter 1166 with a cutoff at approximately 1 - 5 kHz,
20 and through a second amplifier 1170 to a serial port of
microcomputer 1150.

Alternatively, a dual microphone system (not shown)
may be employed to increase reliability, especially when
the custom programmer 1100 is to be programmed in an
25 environment with a high level of background noise that
could interfere with the transmission of data through the
single microphone acoustic means. In this system, one
microphone would be placed near the telephone earpiece and
the second microphone would be placed some distance away
30 from the earpiece in order to pick up background noise.
A audio signal cancellation circuit is then used to
effectively "subtract" the background noise picked up by
the second microphone from the audio data signals combined
with the background noise that is picked up from the first
35 microphone resulting in solely clean audio data signals.

Another preferred embodiment includes a separate
initial set-up programmer 1200 as shown in FIGS. 45. The

1 initial set-up programmer 1200 serves the same basic
function as the telephonic audio signal programming
capability of custom programmer 1100, namely allowing the
total set up of the instant programmer 300 or custom
5 programmer 1100 with a minimum of effort on the part of
the consumer. Normally, initial set-up programmers 1200
would be maintained by sellers of either the instant
programmer 300 or the custom programmer 1100. The initial
set-up programmer could be programmed with the local
10 channel tables for the cable systems and the television
calendars that publish G-codes in the vicinity of the
seller. When a customer purchases an instant programmer
300 or custom programmer 1100, the seller can inquire
where the customer lives and which television calendar the
15 customer uses and use the initial set-up programmer 1200
to download the appropriate local channel table for that
customer. Further, the initial set-up programmer 1200 can
also set the clock, VCR brand and model, and cable box
brand and model for the customer's instant programmer 300
20 or custom programmer 1100.

The initial set-up programmer 1200 includes a
keyboard 1202, a display 1204, an enclosure 1206, and a
lid 1208, with hinges 1209 at the top that allow the lid
to open to reveal a depression 1210 for holding instant
25 programmers 300 and custom programmers 1100 and two
electrical contact pins 1212 as shown in FIG 46. The
initial set-up programmer 1200 includes a modular phone
jack 1230 and a serial port 1232 as shown in FIG. 47 for
transferring data to and from computers, either directly
30 or over telephone lines.

FIG. 48 shows two access holes 1213 in the bottom of
the instant programmer 300 that allow access to two
contact points on the to the circuit board (not shown)
inside the instant programmer 300. FIG. 49 shows the
35 initial set-up programmer 1200 with an instant programmer
300 fit into the depression 1210 with the two contact pins
1212 extending upwards through the access holes 1213 in

1 the bottom of the instant programmer 300. FIG. 50 shows
the initial set-up programmer 1200 with a custom
programmer 1100 fit into the depression 1210 with the two
contact pins 1212 extending upwards through the access
5 holes 1136 in the bottom of the instant programmer 300.

FIG. 51 is a schematic that shows circuitry included
in the initial set-up programmer 1200. The initial set-up
programmer includes a microcontroller (NEC μ PD7530x) 1214,
a liquid crystal display 1216, a keypad 1218, static
10 random access memory (static RAM) 1220, computer port 1222
and programming pins 1224. Local channel tables can be
transferred from a computer to the initial set-up
programmer 1200 and stored in static RAM 1220.

FIG. 52 is a schematic showing the data transfer
15 connection between a personal computer 1226 and initial
set-up programmer 1200. Local channel table data is
output from personal computer 1226 through a serial RS-232
port with +12 and -12 volt signals. The +12 and -12 volt
signals are transformed to TTL compatible 0 and 5 volt
20 signals by level shifter 1228 which are input into
microcontroller 1214. Level shifter 1228 can be either
external or internal to initial set-up programmer 1200.

Alternatively, local channel table data can be
transferred to the initial set-up programmer 1200 by audio
25 signals carried over telephone lines. Further, local
channel tables may be entered into the initial set-up
programmer through keyboard 1202 in the same manner used
to program this information into either instant
programmers 300 or custom programmers 1100.

30 Included in keyboard 1202 are "SEND CLK", "SEND CH",
"SEND CAB" and "SEND VCR", which set the clock, download
the local channel table, select the protocol for the cable
box brand and model and select the protocol for the VCR
brand and model, respectively when they are pressed. If
35 the information is successfully transferred to the instant
programmer 300 or custom programmer 1100 connected to the
initial set-up programmer 1200, display 1204 displays the

1 message "Tr CK", otherwise the message "Tr Err" is
displayed on display 1204.

5 Data is transferred to instant programmer 300 and
custom programmer 1100 through the two contact pins 1212.
The first of these pins is the ground pin. The second pin
connects with test point 392 as shown in FIG. 22. Test
point 392 is connected to both an interrupt pin and one
input/output (I/O) pin of microcomputer 380. The two pins
are tied together with an open collector method so that
10 both input and output can be accomplished with one pin.
The two contact pins 1212 connect to the same functional
pins of the microcomputer 1150 of the custom programmer
1100. Data is transferred serially through these pins at
a 4800 baud rate using TTL voltage levels. The instant
15 programmer 300 and custom programmer 1100 return a low
pulse of a predetermined length to the initial set-up
programmer 1200 when they have received all of transferred
data.

20 The invention as shown in the preferred embodiments
of the custom programmer 1100 and the initial set-up
programmer 1200 can be readily included within
televisions, video cassette recorders, cable boxes, or
satellite receivers. It would not be complicated to embed
either the custom programmer 1100 or the initial set-up
25 programmer 1200 in televisions, video cassette recorders,
cable boxes, and satellite receivers by adding suitable
cabling or other transmission means between various video
devices being used.

30 Another embodiment of the invention is the custom
controller 1300 shown in FIGS. 53-58. The custom
controller contains the same circuitry and performs the
same functions as the custom programmer 1100, but also
perform the functions of a complete universal remote
control that can be set up automatically. The custom
35 controller includes on its main control surface 1302 and
its auxiliary control surface 1304, buttons that perform
the same functions as buttons 1102-1112, 1156 of the

1 custom programmer, a display 1306 that performs the same
functions as display 1134, 1154 and IR transmitters 1314
which perform the same functions as IR transmitters 1131,
1158. The custom controller can also be equipped with a
5 lid (not shown) that covers hidden keys (not shown) used
to set up the custom controller like lid 1114 on the
custom programmer 1100 and lid 316 and keys 316-330 on the
instant programmer 300. The keys under the lid could
include SAVE, ENTER, CLOCK, CH, ADD TIME, VCR, CABLE and
10 TEST keys like the instant programmer and the custom
programmer.

The custom controller includes a microphone 1308,
which performs the same functions as microphone 1140 of
the custom programmer and is accessible through the
15 microphone access hole 1309. Through the microphone, the
custom controller is programmed with all of the set-up
information needed to function as an instant or custom
programmer (i.e., channel map, current time of day,
model/brand of cable box and VCR). Alternatively, the
20 custom controller can be programmed by the initial set-up
programmer 1200 shown in FIGS. 45-47 and 49-51 in the
identical manner described above in connection with these
figures for the instant and custom programmers.
Accordingly, the custom controller includes access holes
25 1310 through which contact can be made with the contact
pins 1212 of the set-up programmer 1200.

Custom controller 1300 also includes additional
buttons on its control surfaces 1302 and 1304 that can
used to operate any home electronic device that can be
30 controlled by an infrared remote control. These standard
infrared remote controls work by transmitting different IR
codes for each different function to be performed by the
device being controlled. Each button of the custom
controller triggers the transmission of an IR code that
35 would ordinarily be transmitted by another remote control.
The actual make up of these IR codes used to control the
various home electronic equipment are described in more

1 detail in United States Patent No. 4,623,887 to Welles, II
which is hereby incorporated by reference.

Most of the time, the custom controller will be used
to control televisions, VCRs, cable boxes, satellite
5 receivers and hi-fi audio equipment. It is noted that
both the instant programmer 300 and the custom programmer
1100 already functioned as universal remote controllers
with respect to video recorders, cable boxes, televisions
and satellite receivers as they can control diverse brands
10 and models of these devices. However, the instant and
custom programmers only use their universal remote
features to change or select channels on cable boxes,
video recorders, televisions and satellite receivers,
begin and end recording by video recorders and turning the
15 power on any of these devices on and off. Nonetheless,
the schematic of the custom controller will be the same as
the schematics of the custom programmer shown in FIGS. 43
and 44 except that the custom controller includes a keypad
(see 1156) with more buttons and the size requirements for
20 the ROM and RAM in the microcomputer (see 1150) are
greater than in the custom programmer. FIGS. 58 and 59
show block diagram schematics for two alternate
embodiments of the custom controller. It is noted these
two schematics contain the same basic components, but the
25 utilization and minimum size of the RAMs 1324 and 1330 and
ROMs 1326, 1332 are different.

The custom controller's complete universal remote
feature operates as follows. Each button on the keyboard
1320, which is mounted on control surfaces 1302, 1304 of
30 the custom controller, is hard wired with a button code or
a memory address, which is generated each time the button
is pressed. The microcomputer 1322 receives the code or
address generated by the pressed button and, if the button
generates a code, consults a look-up table to retrieve an
35 address for the button code. This look up table, as well
as the instructions that control the operation of the
microprocessor are stored in ROM 1326 and 1332.

1 In the embodiment of FIG. 58, the microprocessor
retrieves an IR code from RAM 1324 at the address derived
from the pressed button. In this embodiment, the minimum
size for the ROM is very small as the ROM only needs to
5 store the button code look up table and microprocessor
instructions. However, the size of the RAM needs to be
large enough to store an IR code for each button on the
keyboard.

 In the embodiment of FIG. 59, the microprocessor
10 consults a look-up table in RAM 1330 which contains
address to ROM 1332, which contains the actual IR codes.
The ROM address is retrieved from RAM at the address
derived from the pressed button on keyboard 1320. The IR
code is then retrieved from ROM at the address retrieved
15 from RAM. This embodiment allows the ROM to be
preprogrammed with the IR codes for a large number of home
electronic devices. This increases the minimum size of
the ROM substantially, but reduces the minimum size of the
RAM because ROM addresses are generally shorter than IR
20 codes.

 In both the embodiments of FIG. 58 and 59, the IR
code retrieved from either ROM or RAM is sent by the
microprocessor to IR transmitters 1328 and is transmitted.

 Before the custom controller can be used as a
25 complete universal remote control, it must be programmed
with the IR codes for the functions and the brand and
models of home electronic equipment it is going to
control. Traditionally this has been done in two
different ways. First, the custom controller can "learn"
30 the IR codes for the products that it is to control from
the remote controls that come with each product. The
custom controller would then also include an IR receiver
(not shown) that would receive IR codes from other remote
controls and store these codes and which button on the
35 custom controller each code is associated with into RAM.
This type of "learning" controller usually employs the
schematic of FIG. 58. The second traditional programming

1 method involves providing a ROM that contains the IR codes
for most functions of most brands and models of home
electronic equipment. The user then enters into the
5 custom controller what brand/model of each type of home
electronic device that the user plans to use the custom
controller with. In this method, for each brand and model
of home electronic equipment, the custom controller will
also include in ROM the associations between the IR codes
10 for the equipment and the keys on the custom controller
that will trigger the sending of the IR codes. A
controller utilizing this second programming method
usually employs the schematic of FIG. 59.

In an alternate embodiment, the custom controller can
be programmed by either of both of these methods. IR
15 codes that are "learned" from other remote controllers are
store in RAM 1324 shown in FIG. 58. Alternatively, ROM
1332 shown in FIG. 1332 includes IR codes for most VCRs,
cable boxes, satellite receivers, televisions and stereo
components and the ability to program which brand/model of
20 these device he or she is using. In yet another
embodiment, the embodiments shown in FIGS. 58 and 59 can
be combined by including a flag bit in the data stored in
RAM 1324 or 1330. If the flag bit is set, the rest of the
data at that address is a ROM address which points to the
25 location of the IR code in ROM 1332. If the flag bit is
not set, the rest of the data at that address contains
actual IR code data.

In the preferred embodiment of FIGS. 53-60, though
IR codes are programmed into the memory of the custo
30 controller through the microphone 1308 that is used for
the set up of the channel map, cable box and VCR
brand/model and the current time of day. Using the
process shown in FIG. 60, a process similar to that
described above in connection with the custom programmer
35 1100, in block 1340, the user calls either a special phone
number which could be a toll-free 800 number, a
pay-per-minute 900 number, or a standard telephone number

1 with standard toll charges applying. In block 1342, the
consumer speaks on the telephone to a customer service
representative (representative) located at a remote site
who orally inquires from the consumer the information
5 regarding the brand and model of each home electronic
device with which the consumer wants to use custom
controller. In blocks 1346 and 1348, the consumer also
has the opportunity to tell the representative which
functions each button of the control surfaces 1302 and
10 1304 is to perform. In block 1350, the representative
enters this information into a computer at the remote
site. If the consumer does not have preferences regarding
which button of the custom controller is used to perform
which functions, in block 1352, the representative does
15 not enter any preferences into the computer and the
computer relies on default associations between the
buttons and functions that are previously stored in the
computer.

Once this information has been entered into the
20 computer, in block 1354 the computer programs the custom
programmer in at least two different ways, depending on
whether the embodiment of FIG. 58 or 59 is used. If the
embodiment of FIG. 58 is used, the computer downloads,
through microphone assembly 1334 in either manner
25 described above in connection with the custom programmer
and shown in FIGS. 43 and 44, all of the necessary IR
codes into RAM 1324 at the addresses associated with the
buttons on the keyboard 1320 according to the consumer's
expressed wishes. If this method is used, no IR codes
30 need be stored in the ROM of the custom controller when it
is manufactured.

If the embodiment of FIG. 59 is used, the ROM 1332
installed into the custom controller at manufacture is
programmed with the IR codes of many different brands,
35 models and types of home electronic devices. In this
case, the computer downloads, through microphone assembly
1334, the addresses of the ROM for all of the necessary IR

1 codes into RAM 1330 instead of downloading the IR codes themselves.

5 In an alternative embodiment the ROM 1332 contains default associations between IR codes and buttons of the custom controller, so that these associations need not be downloaded unless the consumer has requested associations between buttons and IR codes that are different from the default associations. This method reduces the amount of data that needs to be sent over the telephone lines from the remote site to the custom controller, but can increase the size and cost of the ROM installed in the custom controller. In the rare case where the IR codes for the device that the consumer wants to control are not included in the ROM, the computer would just download the IR codes themselves for that device as in the first programming method described above with reference to FIG. 58.

15 It is noted above that in either of the embodiments shown in FIGS. 58 and 59, the microphone and decoding assemblies from either FIG. 43 or FIG. 44 may be used. Preferably, the microphone and decoding assembly in FIG. 44 is used as it is less expensive than the assembly in FIG. 43 that uses a DTMF decoder 1166. The system shown in FIG. 44 utilizes just two single frequency signals rather than many dual frequency signals as in a DTMF system. The first signal, a tone of approximately 3000 Hz, is used to signify a binary "one" and the second signal, a tone of approximately 500 Hz, is used to signify "zero." Since a 500 Hz signal is being used in this embodiment, the bandwidth of the 1000 - 5000 Hz high pass filter 1168 from FIG. 44 will have to be broadened to include 500 Hz when included in the microphone and decoder assembly 1334.

25 A series of these two tones are transmitted over the telephone line, representing a binary series. A short period of no signal is included between each tone in the series of tones so that two consecutive 500 Hz or two consecutive 3000 Hz signals are interpreted as two

1 sequential signals and not one long signal. In an
alternative embodiment, the series of signal tones are
sent at a predetermined clock speed.

5 A decoder (not shown) is included between the
microphone assembly 1334 and the microprocessor 1322 that
converts the 3000 Hz signals to high electrical signals
and converts the 500 Hz signals to low electrical signals
that are sent to a serial input into the microprocessor.
A clock signal is simultaneously sent to the
10 microprocessor with each high or low signal.

Alternatively, the initial set-up programmer 1200
could be used to perform the IR code programming of the
custom controller 1300 instead of using the
microphone/telephone interface.

15 The custom controller has several additional
features. First, the rear surface 1312 of the custom
controller is large enough so that custom controller can
be set on the rear surface as shown in FIG. 61 and resist
tipping over. The advantage of being able to stand the
20 custom controller in this upright position is that IR
transmitters 1314 are then at a substantial height above
the surface on which the custom controller is set. This
lessens the probability that pillows, newspapers,
magazines or other debris will be inadvertently placed on
25 top of the custom controller as it will be difficult for
debris to balance on the top of the custom controller when
while in the upright position. Further, stacks of
pillows, magazines and other debris placed next to the
custom controller must be rather high before they will
30 block the IR transmissions of the custom controller. This
feature is extremely important because, unlike the instant
programmer which can have a permanent holder next to the
cable box and VCR, away from magazines and pillows, the
custom controller, having full universal remote
35 capabilities, is designed to be used some distance away
from the video equipment. Yet, to function properly as an
automatic video recorder controller, the IR transmitters

1 of the custom controller need to have a direct line of
sight to the IR receivers of the video equipment to be
controlled.

5 The degree of enlargement of the rear surface 1312
needs to be enough so that the custom controller is stable
and resistant to being tipped over when it is put in the
upright position shown in FIG. 58. Determining an
acceptable size of rear portion is based on several
factors. First, it is usually desirable for the length and
10 the width of the rear surface to be approximately equal.
If the length is significantly greater than the width (as
is the case with traditional prior art universal remote
controls), the controller can be easily tipped over along
the axes that span the width of the rear surface. Next,
15 the proportion of the height of the controller to the
length and width of the rear surface cannot be too great.
A ratio of the length of the rear face to the height of
the controller and of the width of the rear face to the
height of the controller of approximately 3 to 1 or less
20 is usually sufficient. However, this ratio depends on the
uniformity of the density of the custom controller and
thus the center of gravity. If the upper portions of the
custom controller (when it is in the upright position) are
more dense than the lower portions, the center of gravity
25 will be high and the ratio of the width and length of the
rear surface will need to be reduced. On the other hand,
if the lower portions are more dense, the center of
gravity will be lower and the ratio can be safely
increased. One way the center of gravity is lowered is
30 the custom controller is by placing the batteries 1316,
which are comparatively very dense, very near the rear
surface.

35 Another factor in the stability of the custom
controller is the lateral location of the custom
controller's center of gravity. The closer the center of
gravity is to being directly above the center of the rear
surface when the custom controller is in the upright

1 position, the more stable the custom controller will be.
It is noted that the upper portion of embodiment of the
custom controller shown in FIGS. 53-58 is off center.
This moves the center of gravity away from the center of
5 rear surface slightly, but adds to the aesthetic
appearance of the custom controller.

The shape of the rear surface is not particularly
relevant, but rather the shortest distance across the rear
surface. On the other hand, the shape of the back surface
10 of the custom controller is significant. Preferably, the
back surface is semicircular or substantially
semicircular. The closer the back surface is to a
semicylindrical shape, the more comfortable the custom
controller is for a consumer to hold, as the cylindrical
15 shape fits better into human hands.

Another feature of the custom controller is its two
control surfaces 1302 and 1304. Auxiliary control surface
1304 is designed to include buttons that will be used most
often when the custom controller is in its upright
20 position, such as volume up and down controls. The angle
between the rear surface and the auxiliary control surface
is less than or equal to 45° . Keeping the angle less than
or equal to 45° directs at least half of the force needed
to press button on the auxiliary control surface downwards
25 into the table or other surface the custom controller is
resting on instead of sideways, which would tend to topple
the custom controller when it is in the upright position.

Two alternative embodiments of the custom controller
1300 are shown in FIGS. 65-70 and FIGS. 71-76. These
30 controllers include control faces that are at angles from
the rear face of less than or equal to 45° , substantially
circular bottom faces and rear faces that are larger
relative to prior art remote controls.

Yet another feature of the custom controller are one
35 touch channel tuning buttons. These buttons would be
assigned to a specific television or cable channel such as
HBO, ESPN, CNN or MTV. For example, if a button is

1 assigned to CNN, when the CNN button is pressed, the
custom controller transmits IR codes to change the channel
on a television, VCR, cable box or satellite receiver to
the channel number on which CNN is broadcast. When the
5 consumer sets up the custom controller, he or she tells
the representative what channels he or she watches the
most and the representative directs the computer to have
selected keys on the custom controller be programmed to
tune these channels. The consumer tells the
10 representative which keys on the custom controller he or
she wishes to tune which channels or the representative
can select the keys. After the keys and channels have
been selected, the consumer then writes the channel names
next to the keys that tune them or labels with different
15 channel names can be supplied which are then applied to
the custom controller next to the appropriate buttons.
These one touch tuning buttons are particularly well
suited to being programmed as buttons on the auxiliary
control surface, so that the consumer can operate these
20 buttons without having to pick up the custom controller.

It is thought that the universal remote that includes
apparatus and method using compressed codes for television
program record scheduling of the present invention and
many of its attendant advantages will be understood from
25 the foregoing description and it will be apparent that
various changes may be made in the form, construction and
arrangement of the parts thereof without departing from
the spirit and scope of the invention or sacrificing all
of its material advantages, the form hereinbefore
30 described being merely a preferred or exemplary embodiment
thereof.

1 WHAT IS CLAIMED IS:

5 1. A remote control for transmitting control codes
for control of home electronic devices and for using
compressed codes for automatically recording video
signals, by a video recorder, under control of sets of
channel, date, time-of-day and length commands, the remote
control comprising:

10 means for entering compressed codes, each
representative of, and compressed in length from, a set of
individual channel, date, time-of-day and length commands;

 means for decoding said compressed codes into
sets of individual channel, date, time-of-day and length
commands;

15 a keypad comprising a plurality of buttons;

 means for storing control codes for control of
home electronic devices and for storing associations
between said buttons and said control codes

20 means for retrieving from said storing means,
when one of said buttons is activated, any such control
codes associated with such activated button;

25 a transmitter for transmitting retrieved control
codes and for transmitting record on, record off and
channel select control codes according to said individual
channel, date, time-of-day and length commands; and

 means for receiving said control codes and said
associations between said control codes and said buttons
for storage in said means for storing.

30 2. The remote control of claim 1 wherein said means
for receiving are coupled to a computer.

35 3. The remote control of claim 1 wherein said means
for receiving are coupled to a computer through a
telephone line.

 4. The remote control of claim 1:

1 wherein said means for storing further comprise
means for storing at least one local channel number for at
least one channel number in said channel command; and

5 wherein said means for receiving further
comprise means for receiving local channel numbers
corresponding to channels numbers in said channel commands
and the correlation of said local channel numbers to said
channel numbers in said channel commands for storage in
said means for storing; and

10 wherein said transmitter transmits said channel
commands according to local channel numbers stored in said
storing means to said means for channel selection
according to said individual date, time-of-day and channel
commands.

15 5. The remote control of claim 4 wherein said means
for receiving are coupled to a computer.

20 6. The remote control of claim 4 wherein said means
for receiving are coupled to a computer through a
telephone line.

 7. The remote control of claim 1 further
comprising:

25 a clock;

 means for setting said clock according to
signals representative of time;

 wherein said means for receiving further
comprise means for receiving said signals representative
30 of time.

 8. The remote control of claim 7 wherein said means
for receiving are coupled to a computer.

35 9. The remote control of claim 7 wherein said means
for receiving are coupled to a computer through a
telephone line.

1

10. A remote control comprising:
a rear face;
a bottom face connected to said rear face;
5 a top face connected to said rear face;
at least one transmitter located at the end of
the top face opposite said connection to said rear face;
wherein the length of the top face, measured
from said connection to said rear face to the opposite end
10 of said top face is greater than the minimum of the length
and width of the rear face.

11. The remote control of claim 10 wherein said top
face comprises a substantially flat control surface.
15 including buttons, that is at an angle of less than
forty-five degrees from said rear face.

13. The remote control of claim 10 further
comprising batteries, fixed in a position substantially
20 adjacent to said rear face.

12. A method of programming a universal remote
control with control codes for controlling a home
electronic device comprising:

25 entering information sufficient to identify the
control codes needed to control said home electronic
device into a computer;

30 downloading said control codes through an audio
connection from said computer to said universal remote
control.

35

1 **APPARATUS AND METHOD USING COMPRESSED CODES
FOR TELEVISION PROGRAM RECORD SCHEDULING**

Abstract of the Disclosure

5 Encoded video recorder/player timer preprogramming
information listed in a television calendar allows a timer
preprogramming feature on a video cassette recorder VCR to
be programmed using a compressed code of as few as 1 to 8
10 digits, which are decoded by a decoder built into a remote
control, video cassette recorder, television or other
video device to convert the compressed code into channel,
date, time and length information. The channel, date,
time and length information is used to select channels,
start recording, and stop recording at the appropriate
15 time. A local channel map is stored so that the channel
information from the compressed codes can be utilized to
tune the correct channel even though channel numbers in
different localities may be different. The remote may be
a universal remote control capable of selecting between
20 various stored infrared code protocols for commanding
different brands and model of video devices. The remote
may also be a complete universal remote control that
transmits infrared codes to a variety of home electronic
devices upon the user pressing buttons associated with the
25 functions associated with the infrared codes. The
programming of local channel map data, infrared codes and
protocols and their association with specific buttons on
the remote control can be accomplished by the remote
control's keyboard or by an external device, including
30 external devices that accomplish the programming by
transmissions over telephone lines.

FIG. 1

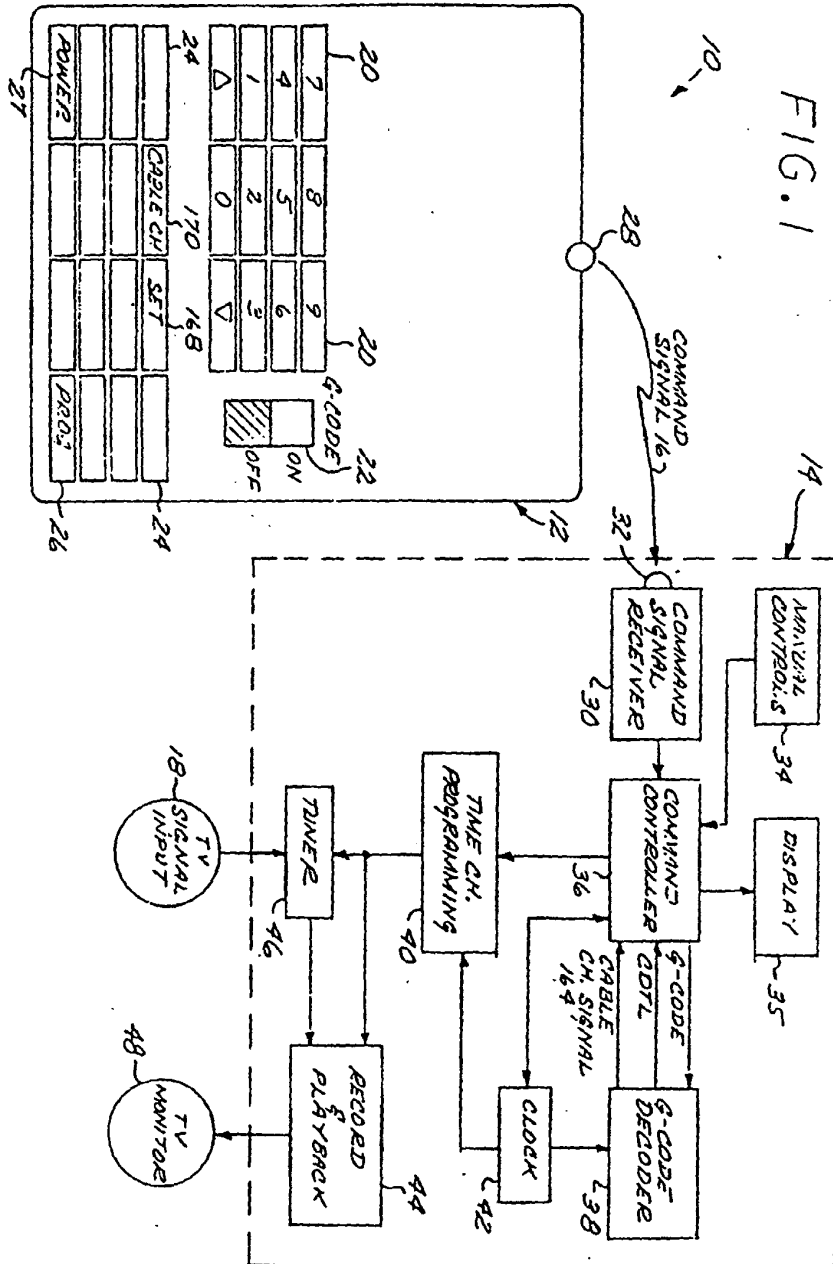


FIG. 2

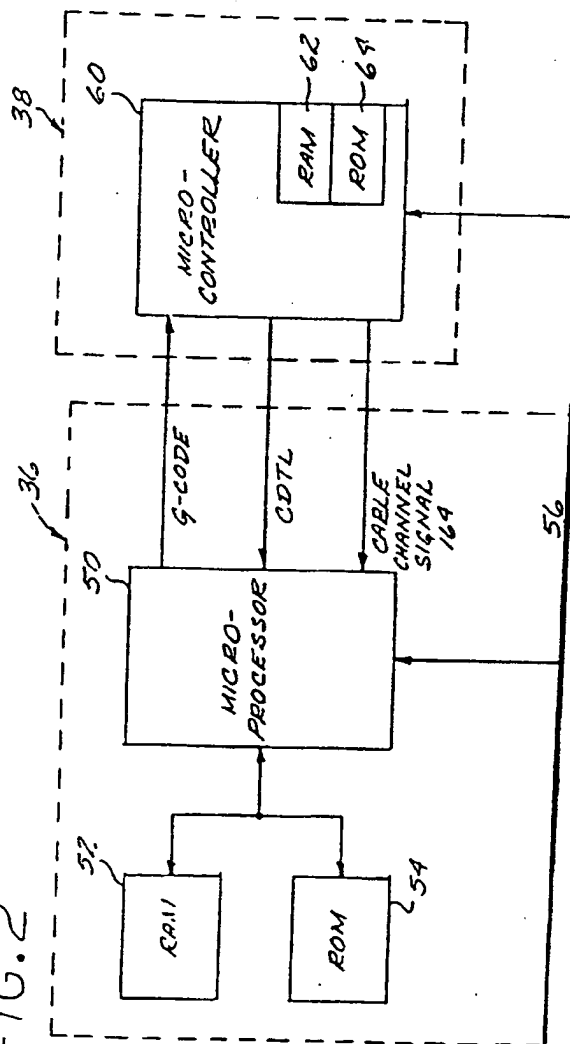


FIG. 3

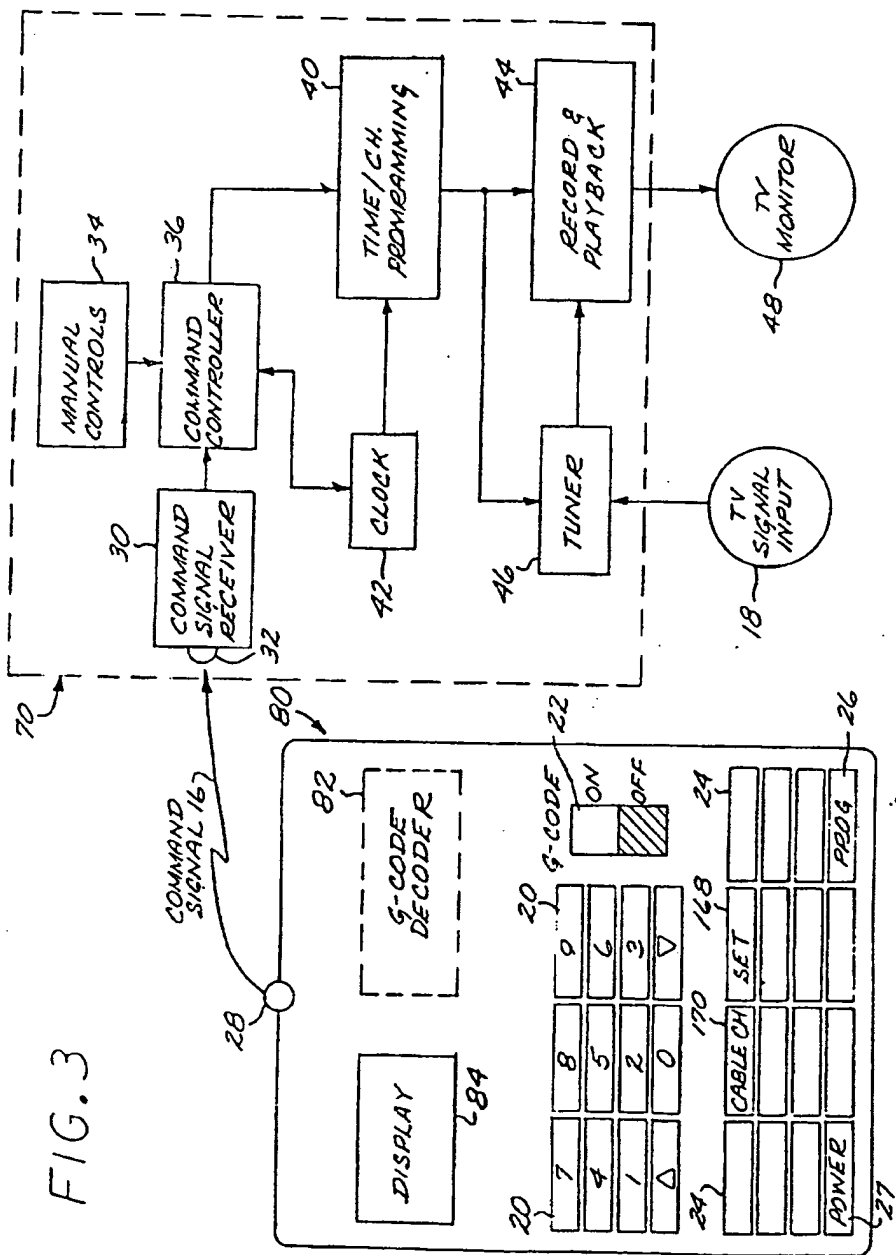


FIG. 4

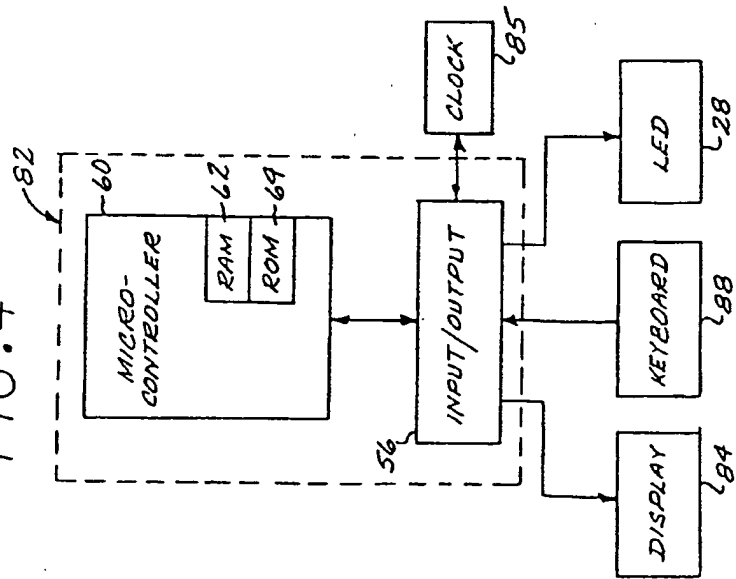


FIG. 5

IR SIGNAL FROM
REMOTE CONTROLLERS
98
COMMAND
SIGNALS
16

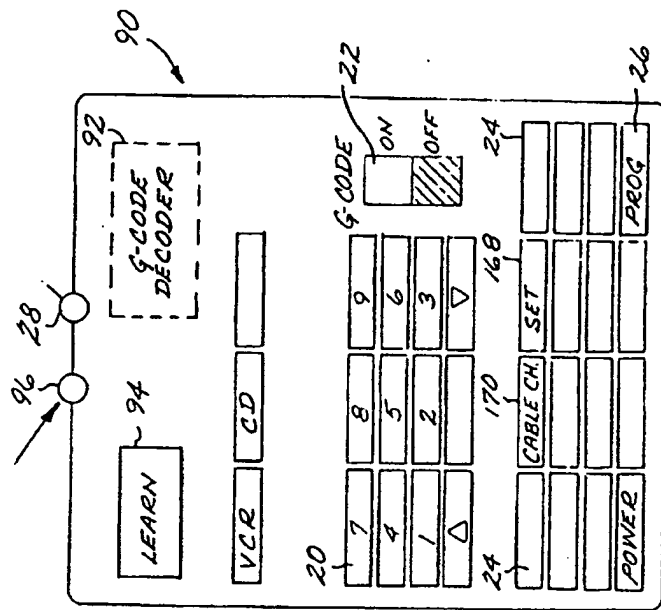
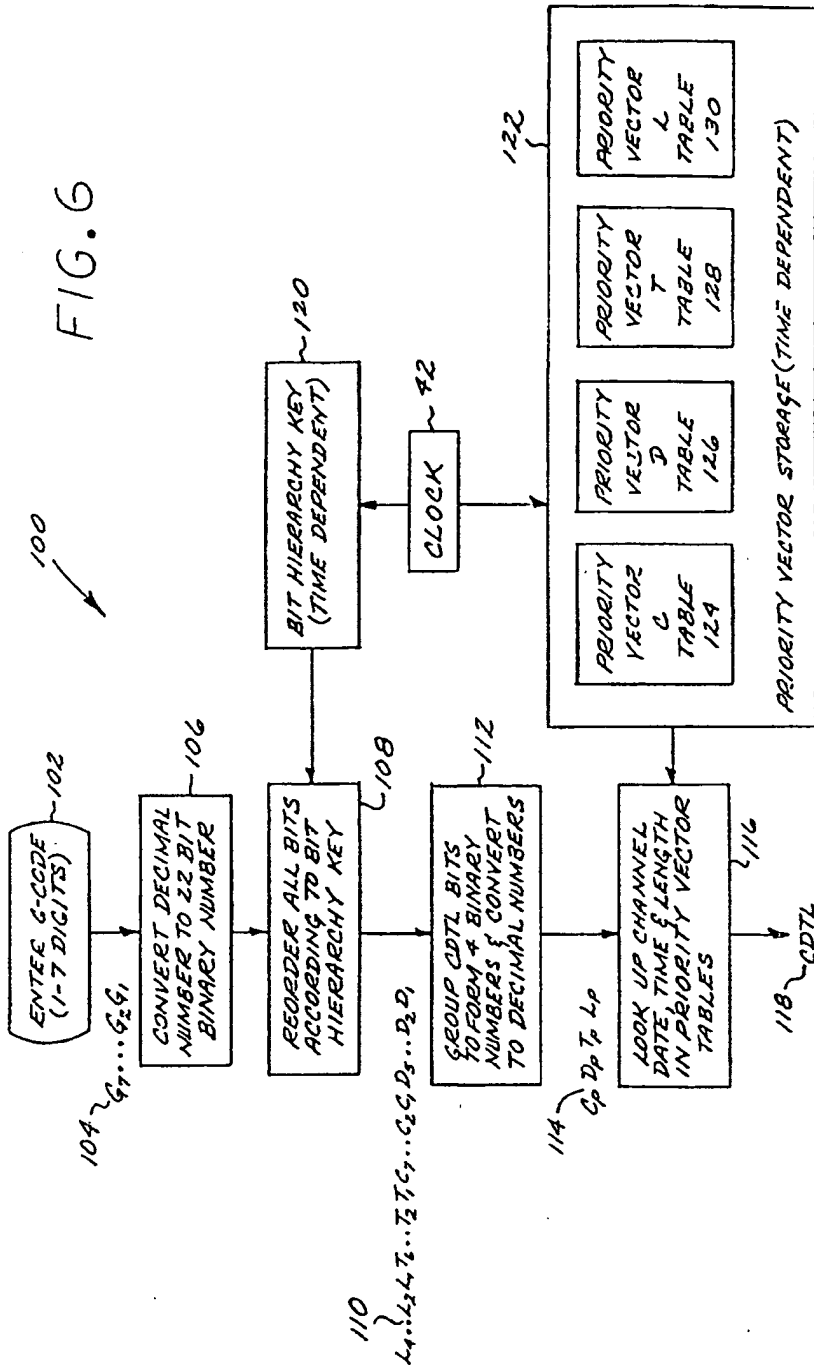
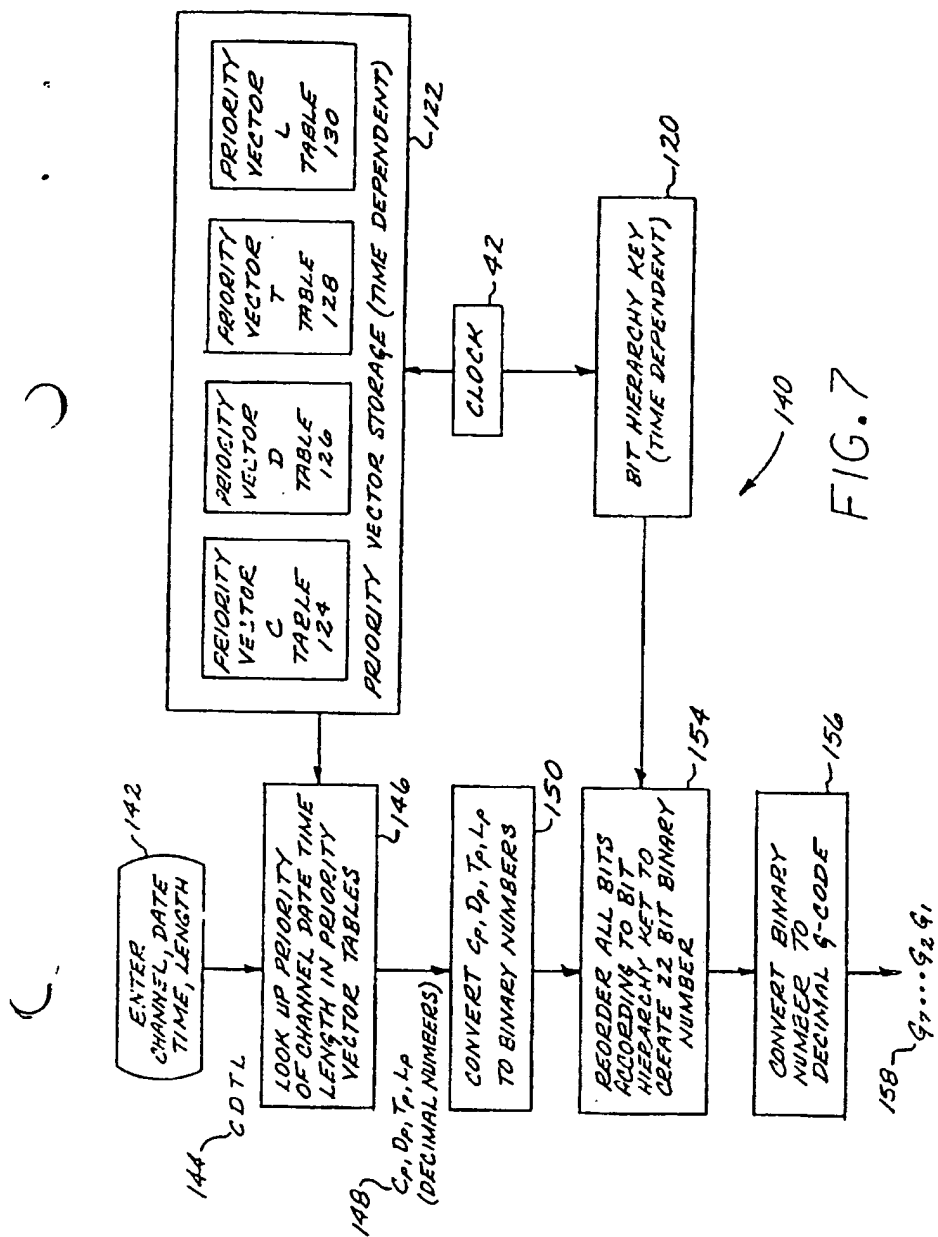


FIG. 6





THURSDAY 204

FEBRUARY 9, 1989 - 202

203 [6] SPORTS RETROSPECTIVE; 60 MIN. [68713] 200
6 PM [24] NATURE SCENE [5321]
206 A VISIT TO THE COLORADO NATIONAL MONUMENT
210 NEAR GRAND JUNCTION WHERE WILDFLOWERS,
INSECT AND BIRDS ARE OBSERVED
[32] [52] NOTICIAS [62921] [496649]
[40] DWIGHT THOMPSON -- RELIGION; [68553]
[50] HUMANITIES THROUGH THE ARTS [493065]
[50] BEVERLY HILLBILLIES -- COMEDY [496777]

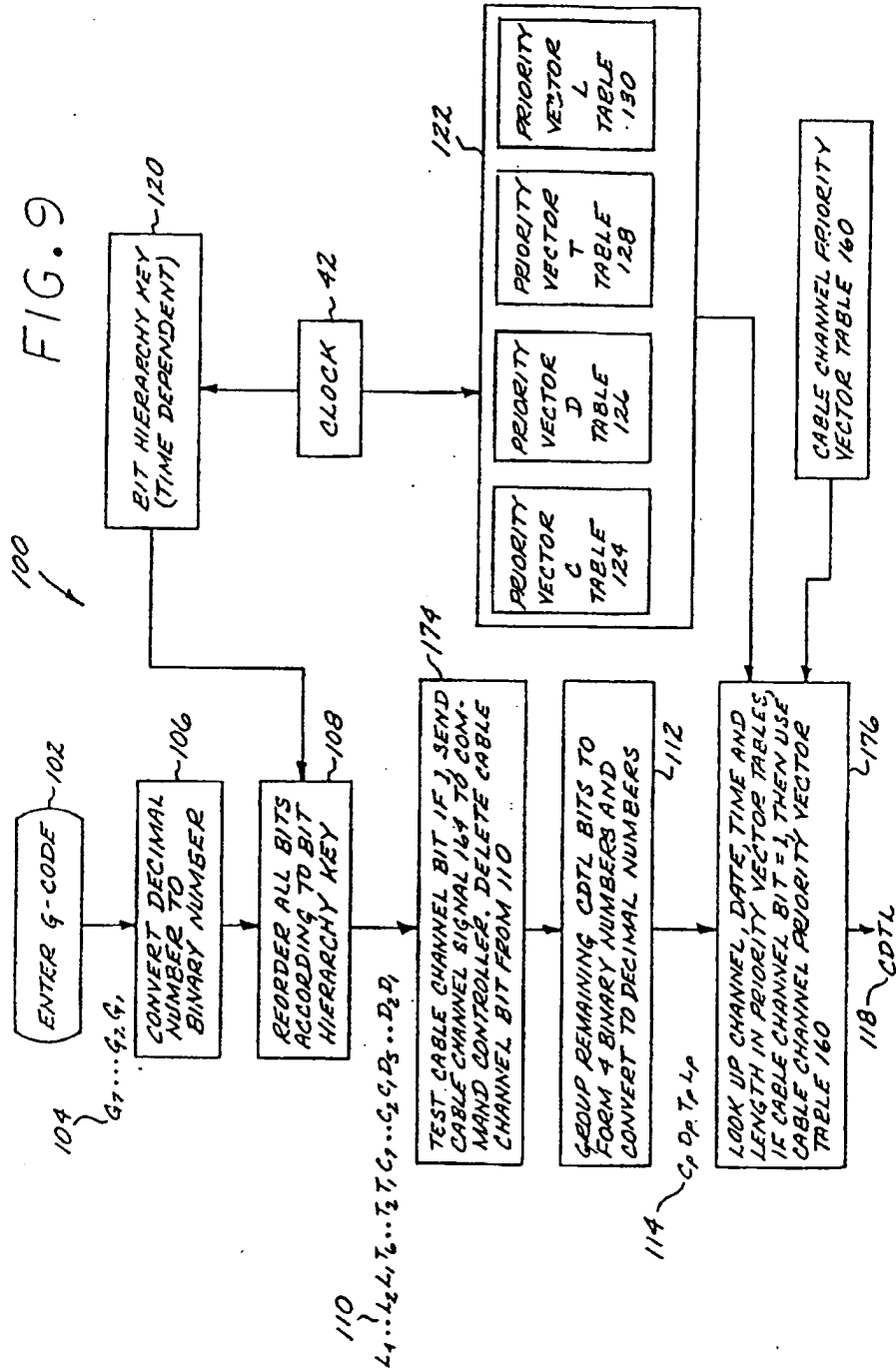
FRIDAY 204

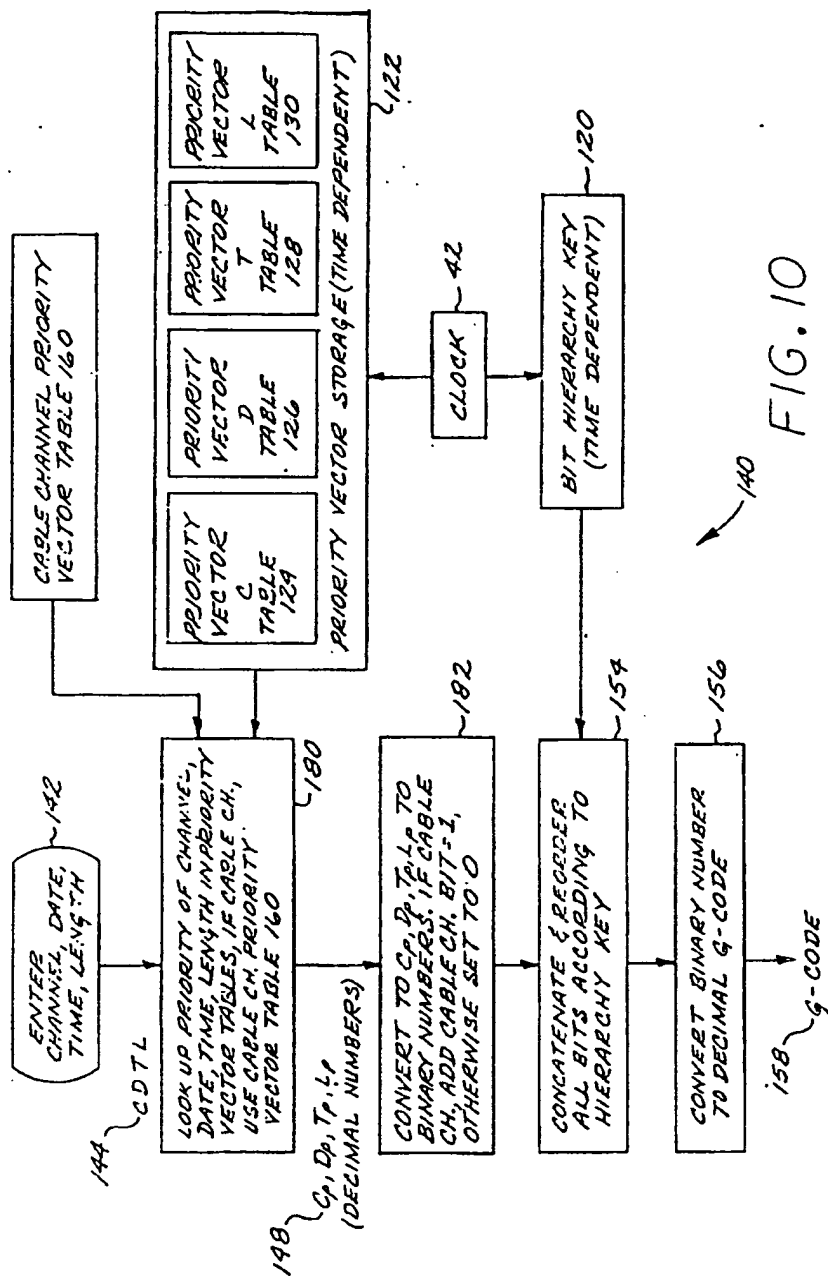
FEBRUARY 10, 1989 - 202

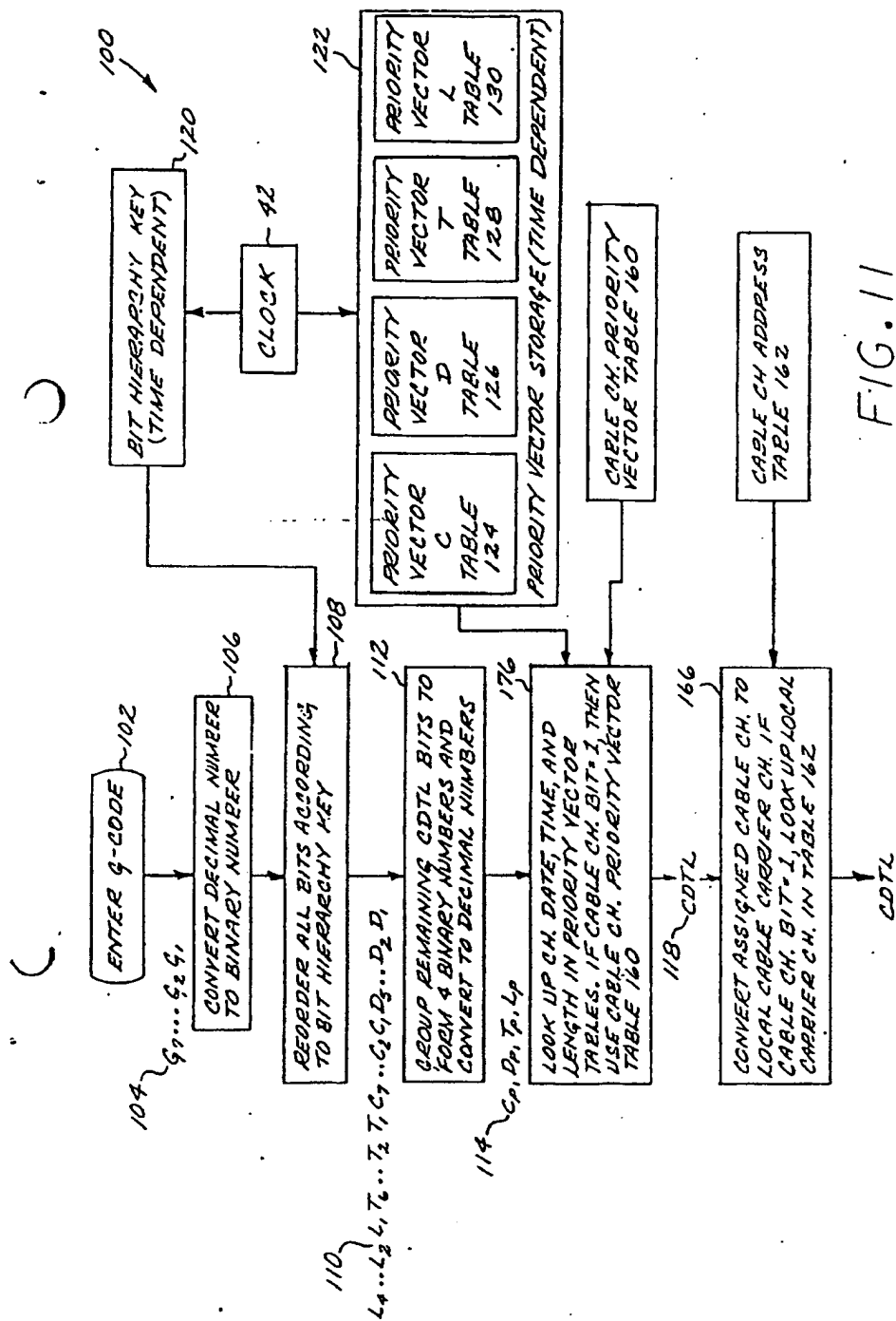
[CB] [D13] MOVIE -- DRAMA; 70 MIN. (23627113)
6:30 [1] FAMILY TIES (CC) -- COMEDY [15657]
206 MALLORY'S REUNION WITH HER COLLEGE BOY FRIEND 200
(JOHN DUKAKIS) HAS HER WORRIED THAT SHE MAY
208 NOT BE AS INTERESTING TO HIM AS SHE ONCE WAS.
[50] HOÇAN'S HEROES - COMEDY [510857]
188 CARTERS MASQUERADE AS A TRAITOR MAY BE
KAPUT: A LOVELY FRAULEIN IS TRYING TO POISON HIM
[214] [NIK] DOUBLE DARE - GAME (29225) 212
[211] [TNN] VIDEO COUNTRY (29129)
[27] [USA] CARTOON EXPRESS (23561)
7 PM [5] CHARLES IN CHARGE (CC) - COMEDY [1065]
206 WHILE PLANNING A PIZZA-PAKOE PARTY CHARLES
ALIENATES THE POWERFUL CHILDREN BY DISMISSING
THEIR SUGGESTIONS ABOUT ORGANIZING THE EVENT

FIG. 8

FIG. 9







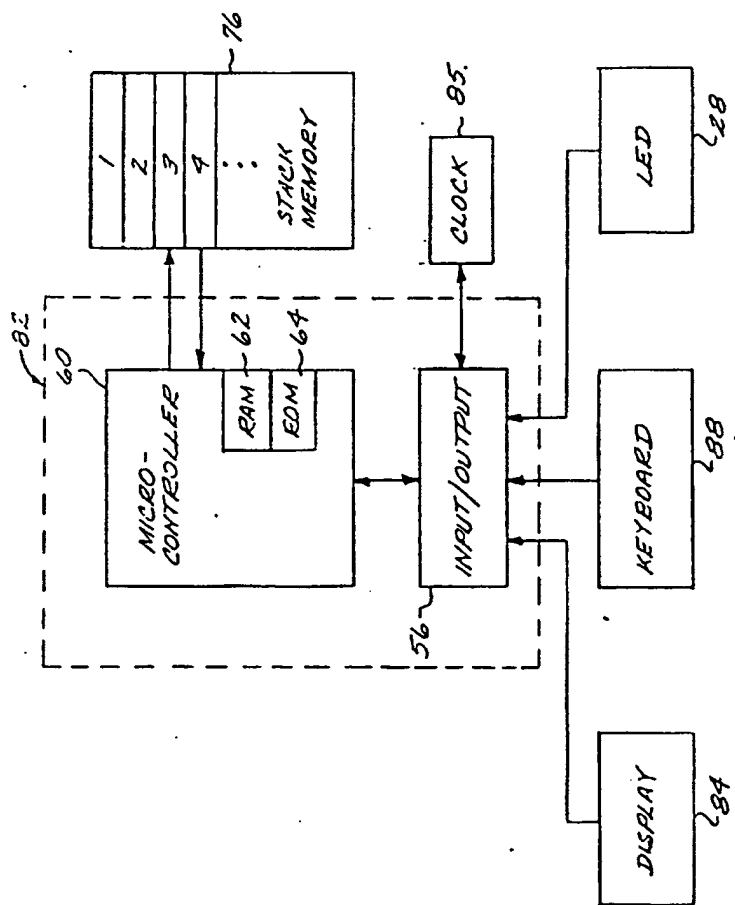


FIG. 12

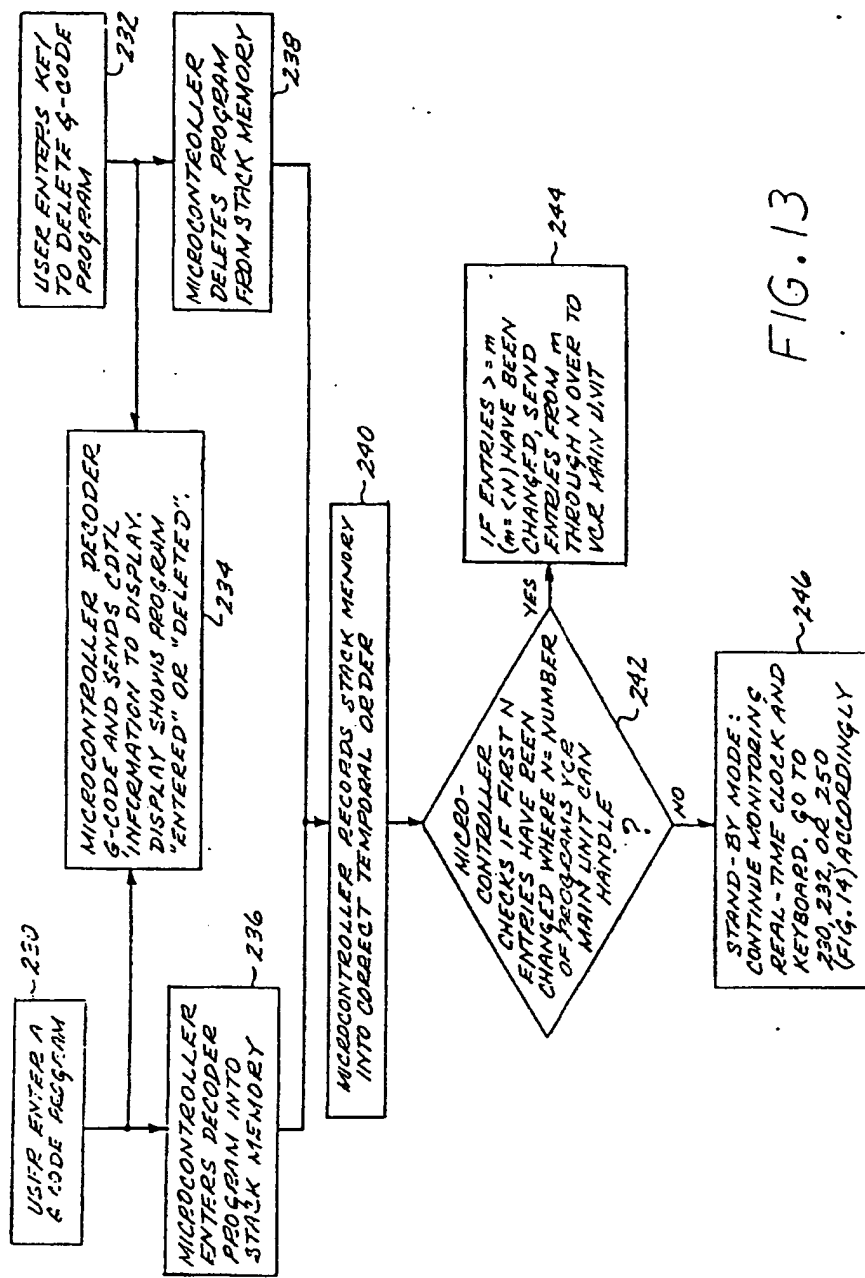


FIG. 13

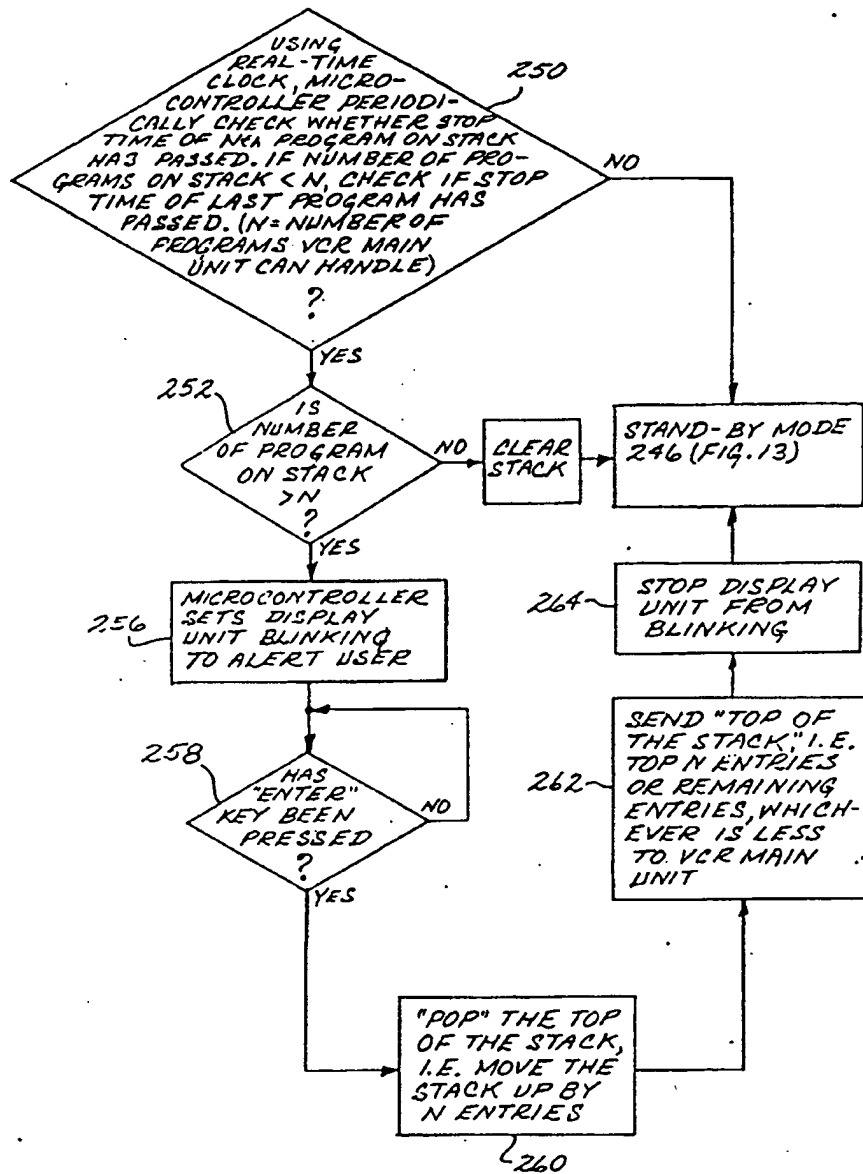


FIG. 14

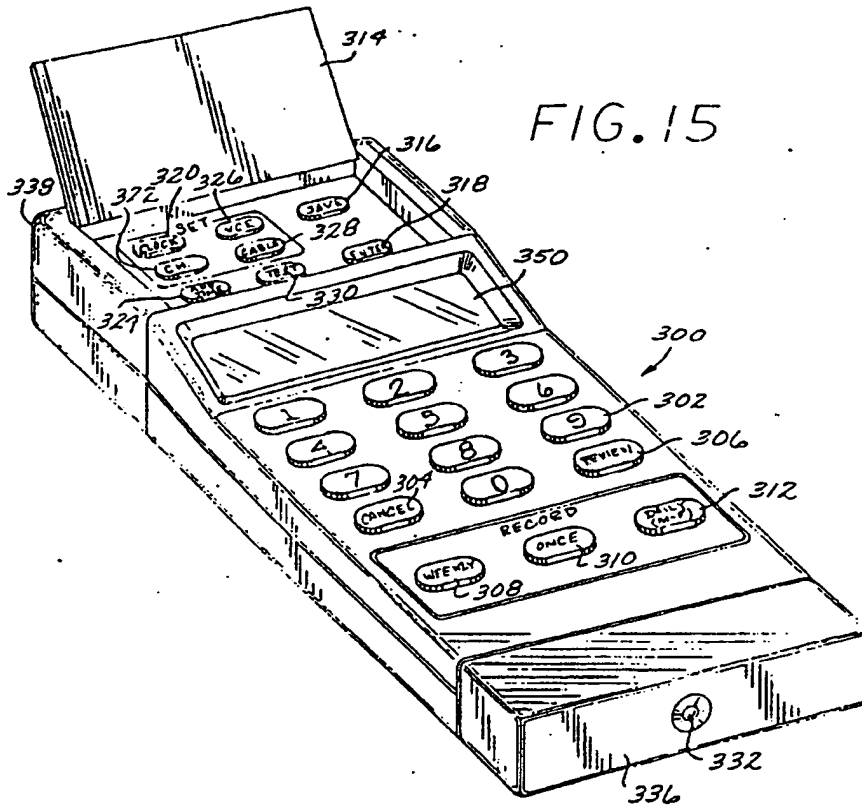
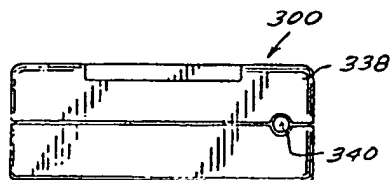
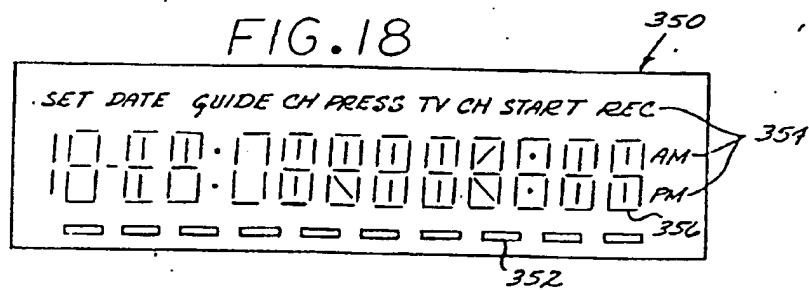
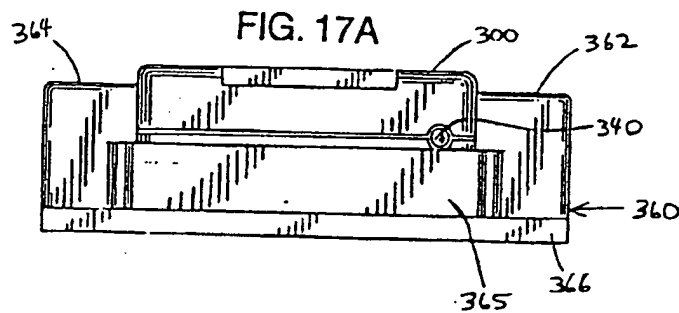
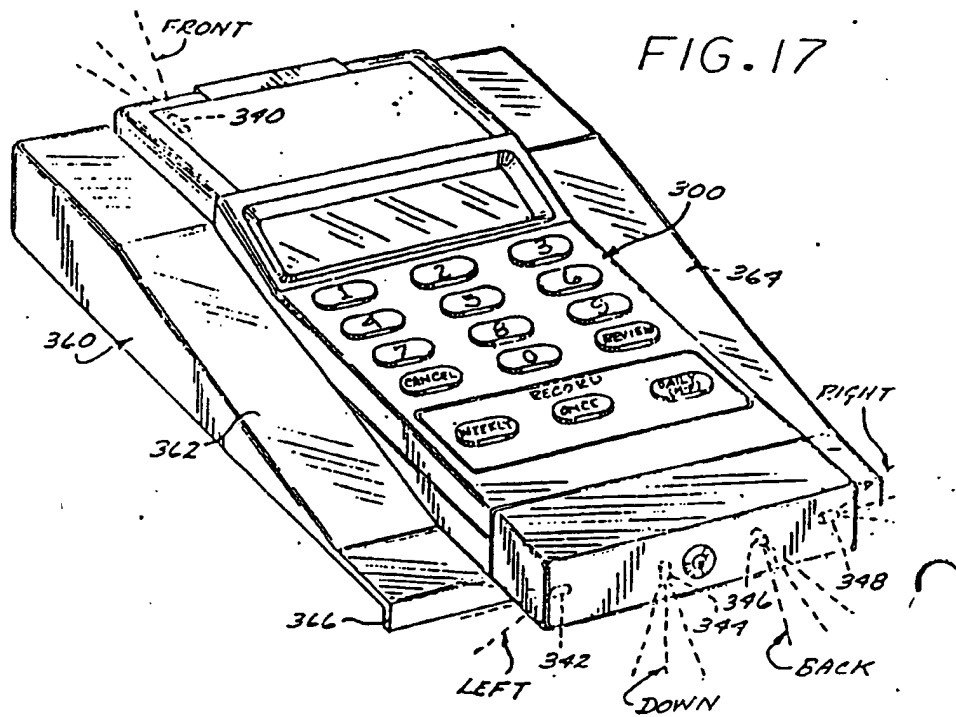


FIG. 16





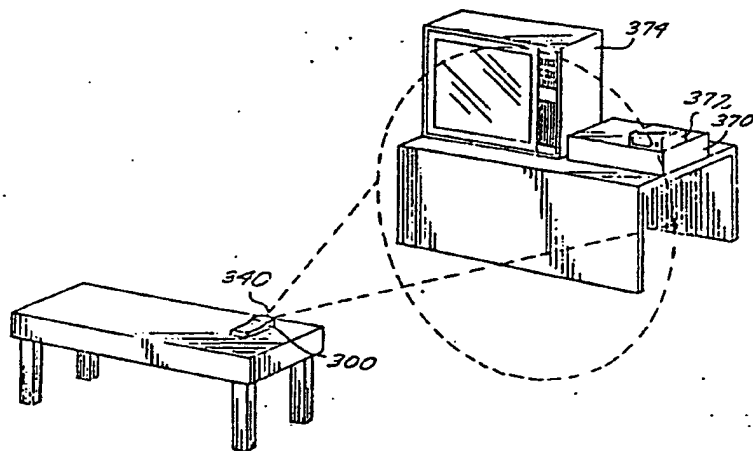


FIG. 19

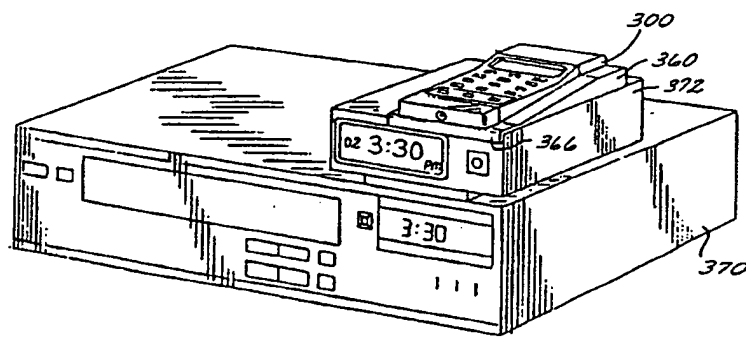


FIG. 20

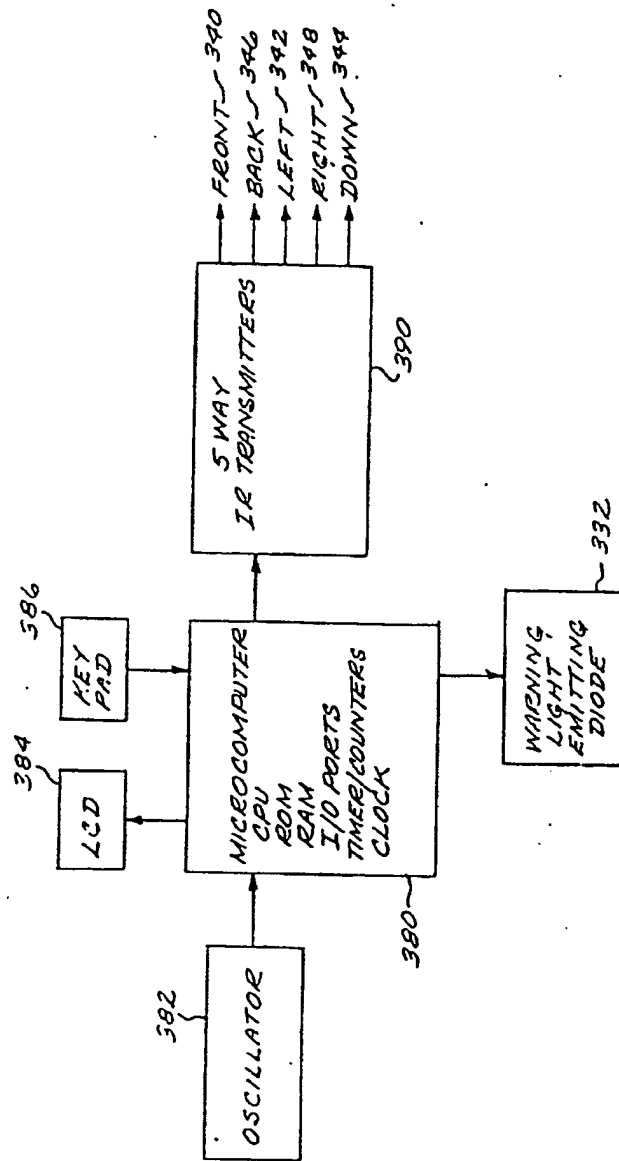


FIG. 21

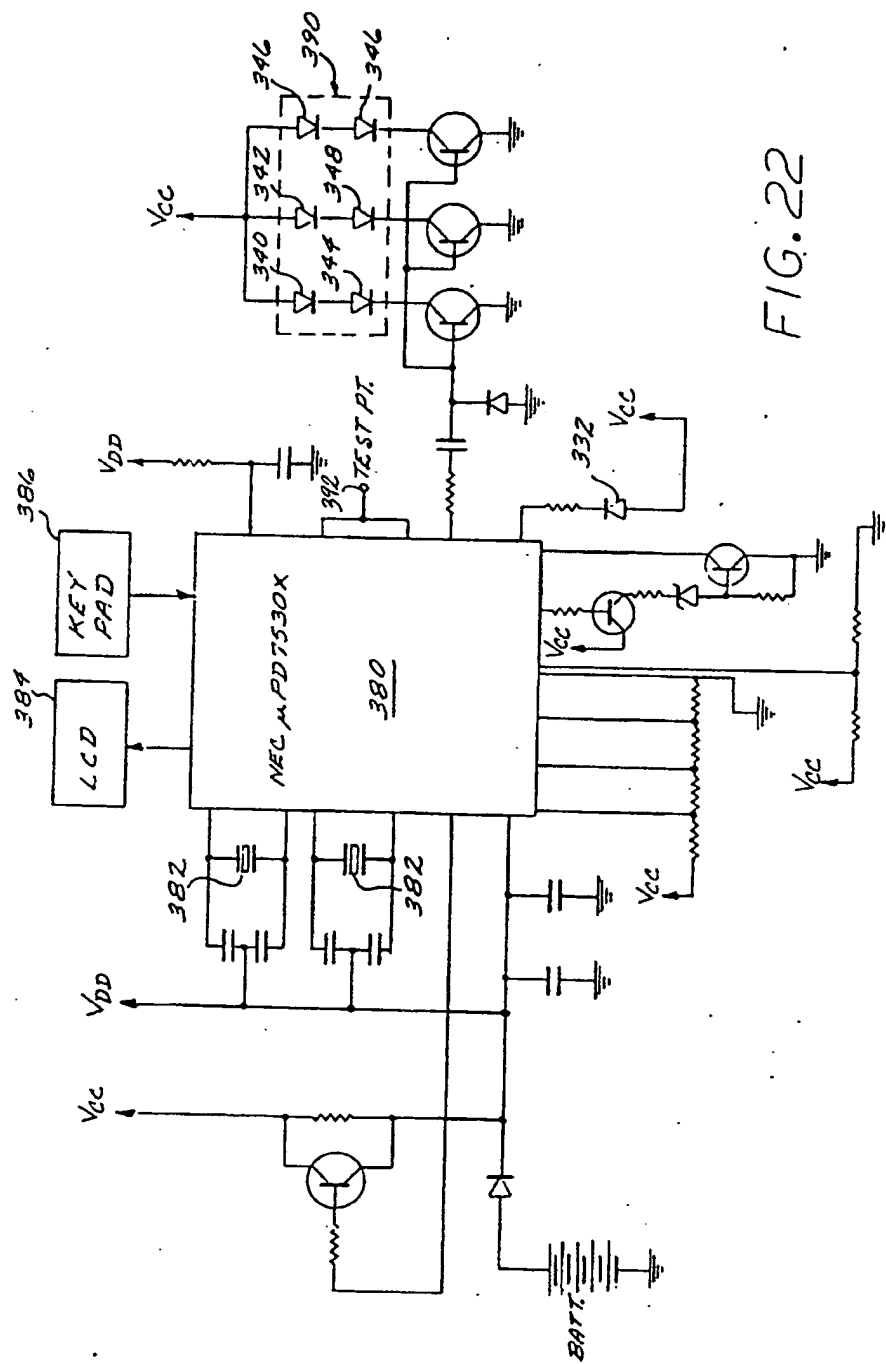


FIG. 22

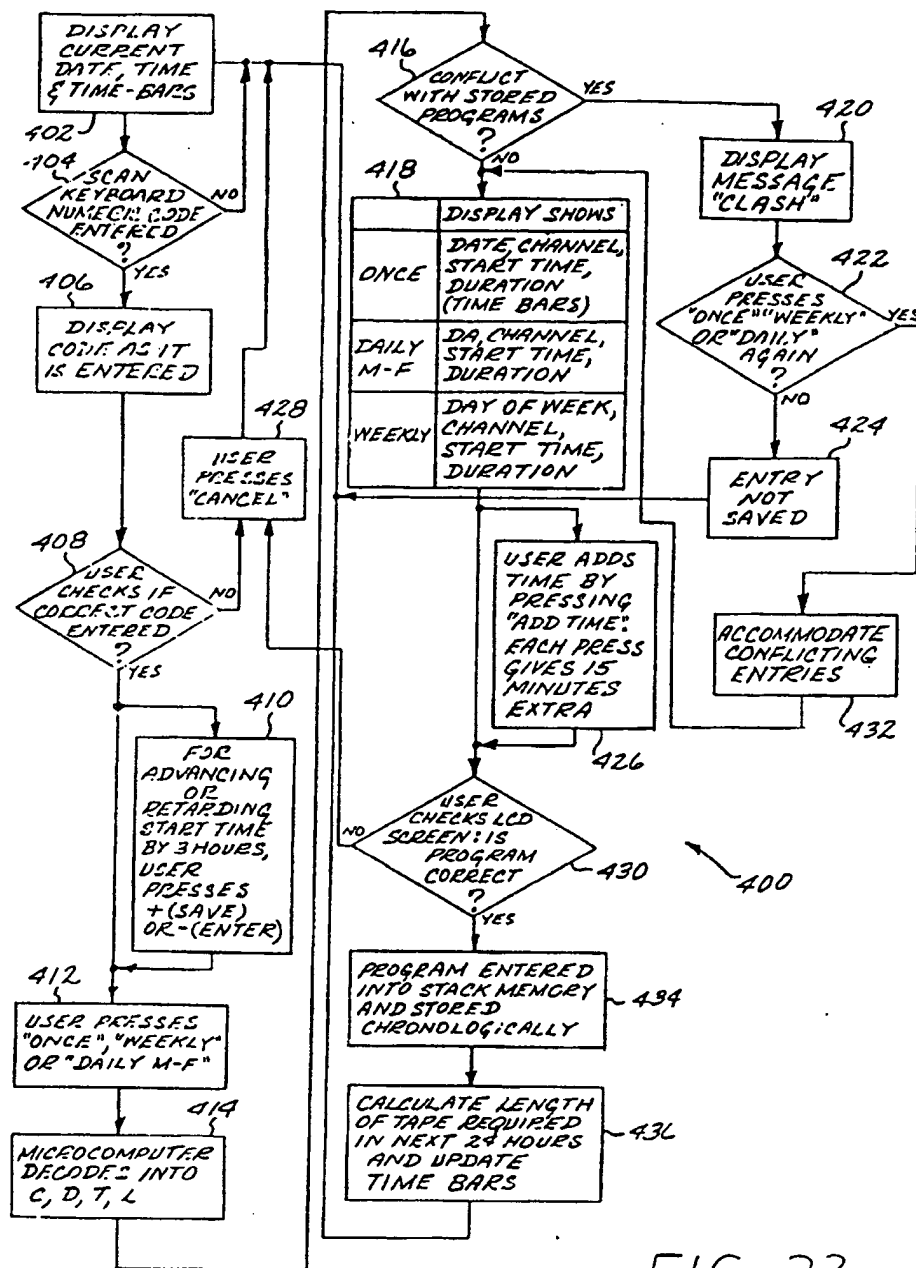


FIG. 23

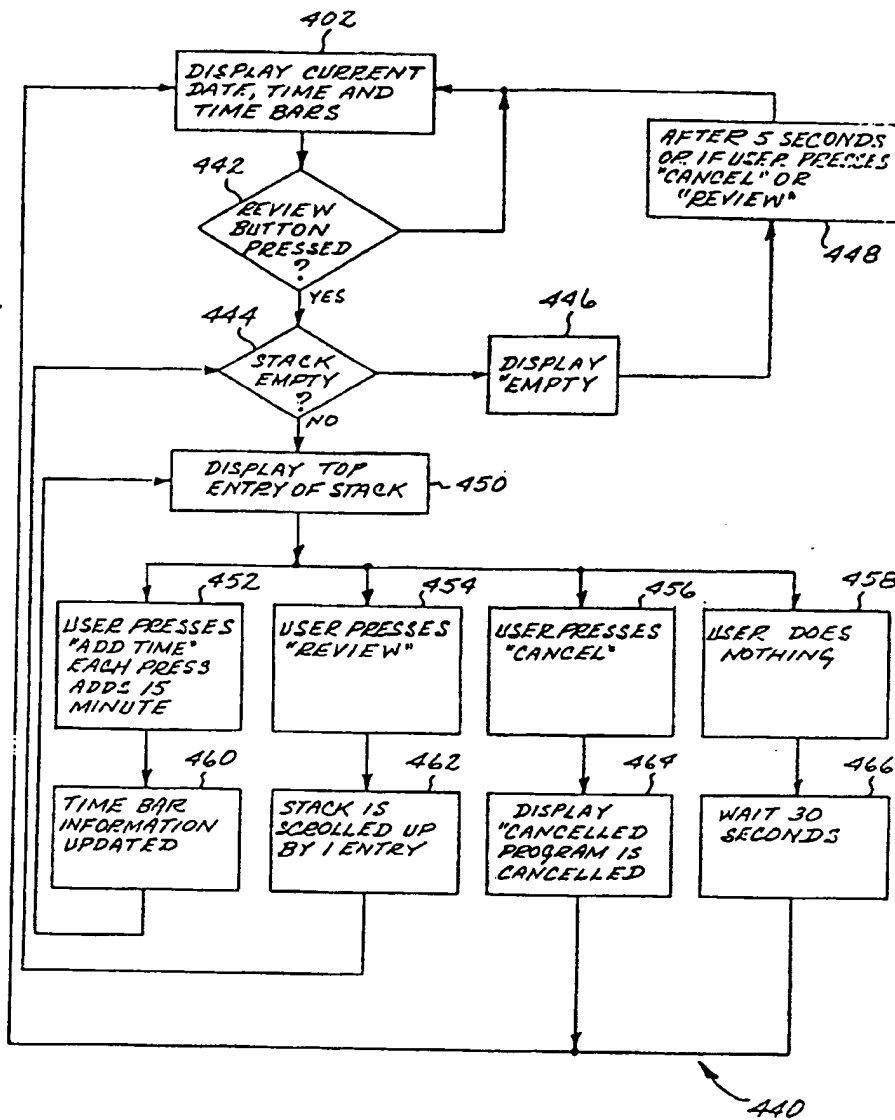


FIG. 24

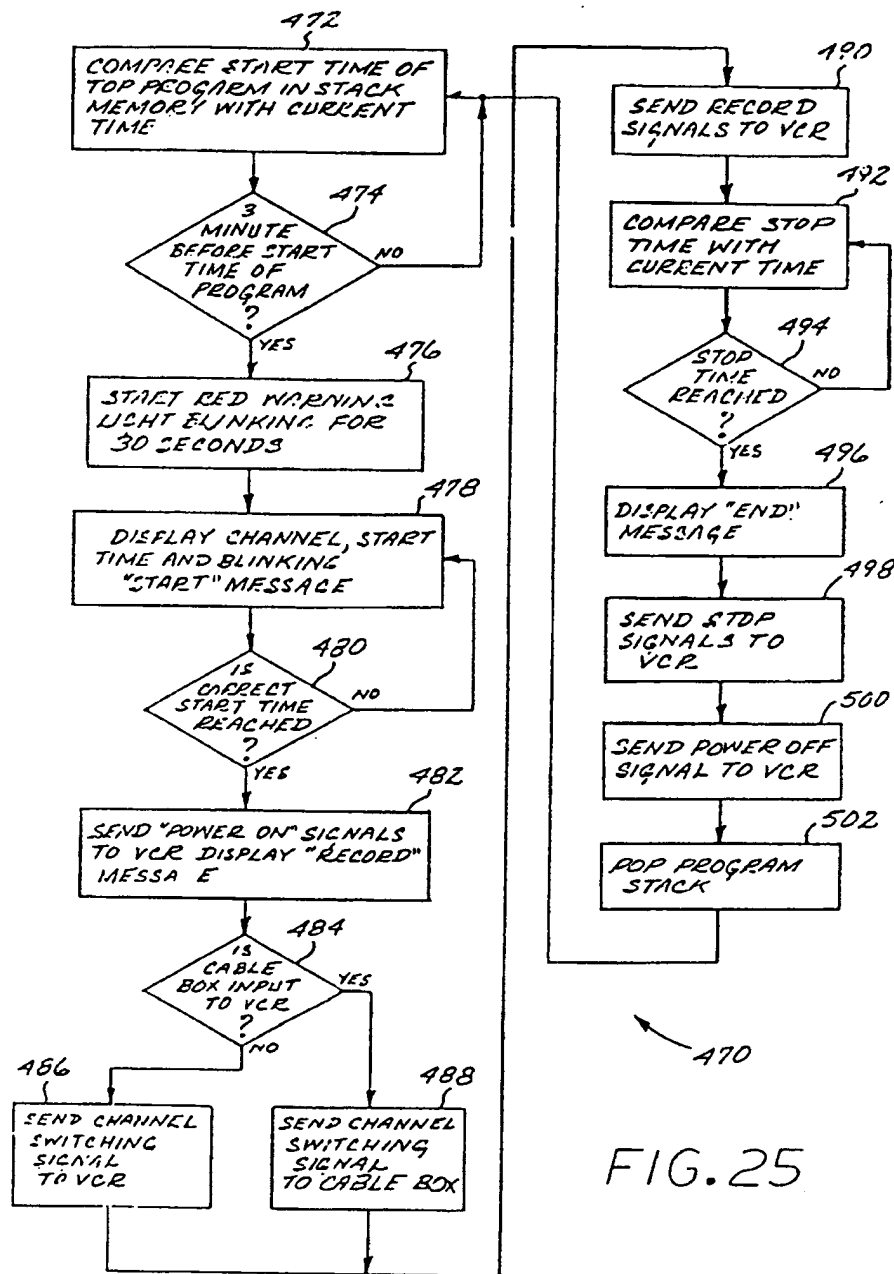


FIG. 25

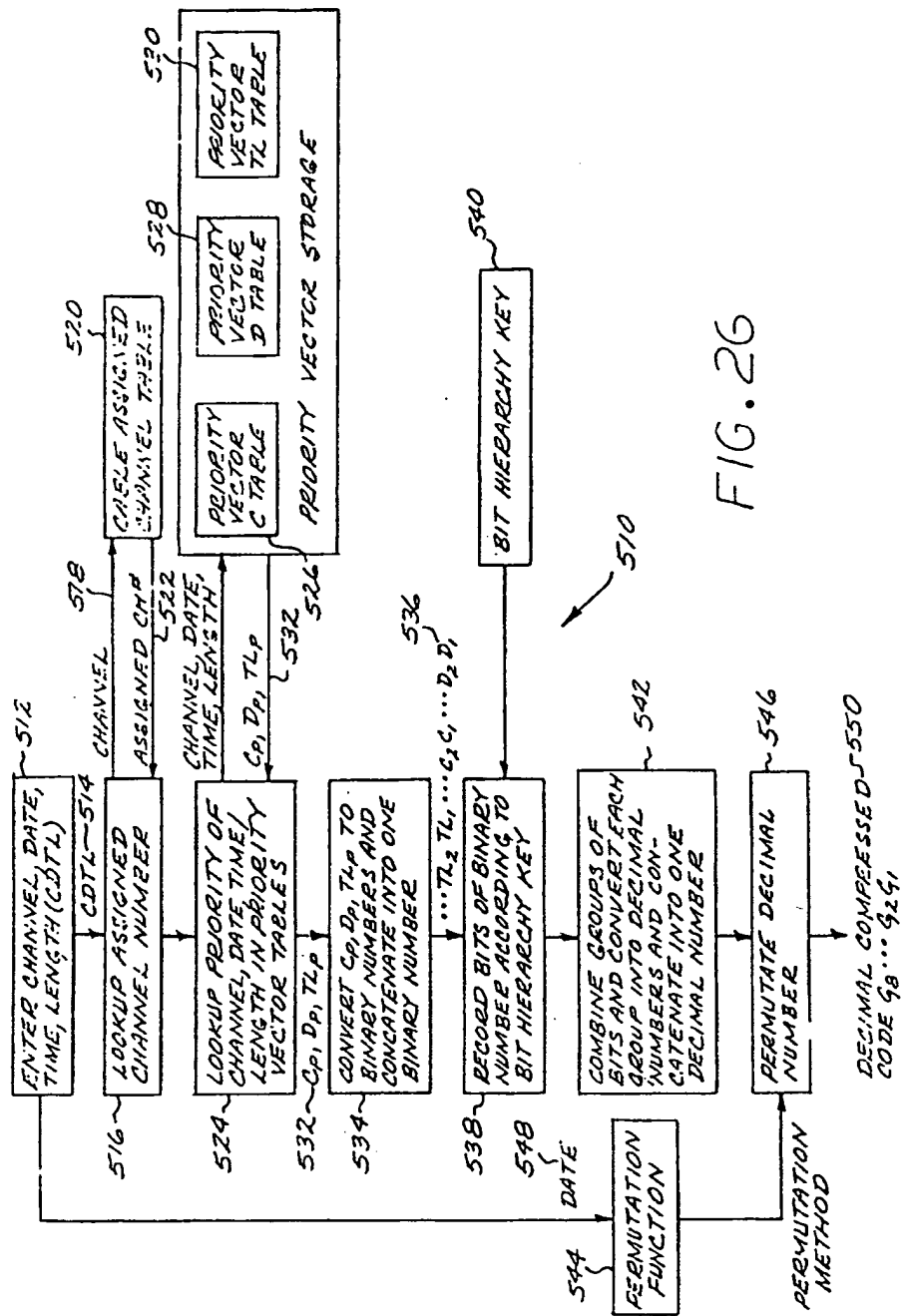
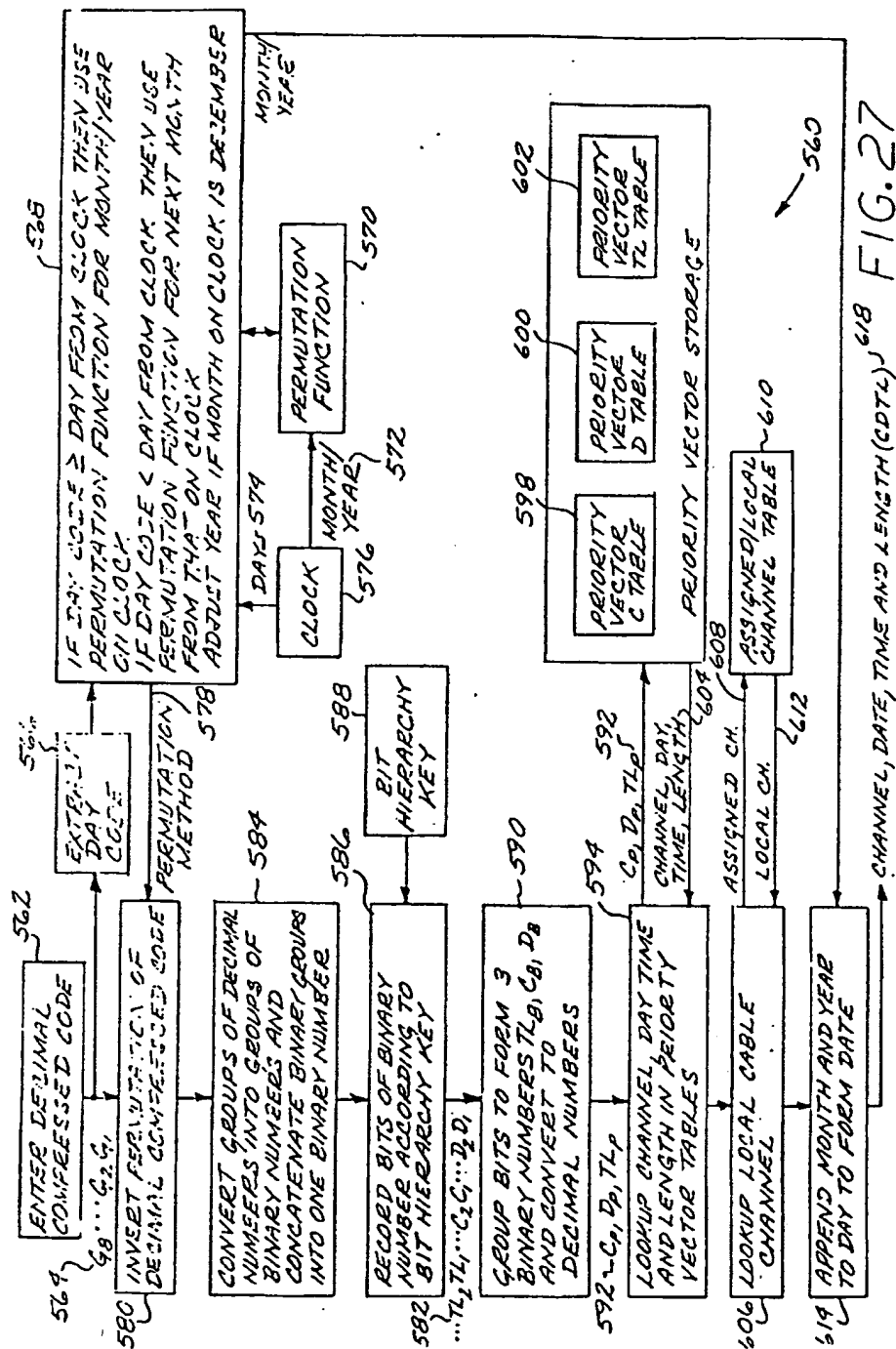


FIG. 26



| | ASSIGNED CHANNEL NUMBERS | LOCAL CHANNEL NUMBERS |
|-----------------------|--------------------------------|-----------------------------|
| | GUIDE CH. | TV CH. |
| BROADCAST CHANNELS | | |
| WBBM(CBS) | 2 | 2 |
| WMAQ(NBC) | 5 | 5 |
| 622~WLS(ABC) | 7 | 7 |
| WGN | 9 | 9 |
| WTTN(PBS) | 11 | 16 |
| WPWR | 50 | 45 |
| WGBO | 66 | 48 |
| CABLE CHANNELS | 629 | |
| A&E | 10 | 10 |
| 632~AMC | 4 | 4 |
| BET | 25 | 8 |
| BEAV | 24 | 29 |
| CNCB | 36 | 36 |
| CNN | 13 | 35 |
| CSPAN | 27 | 30 |
| DIS | 23 | 25 |
| ESPN | 3 | 6 |

628

620

FIG.28

Q

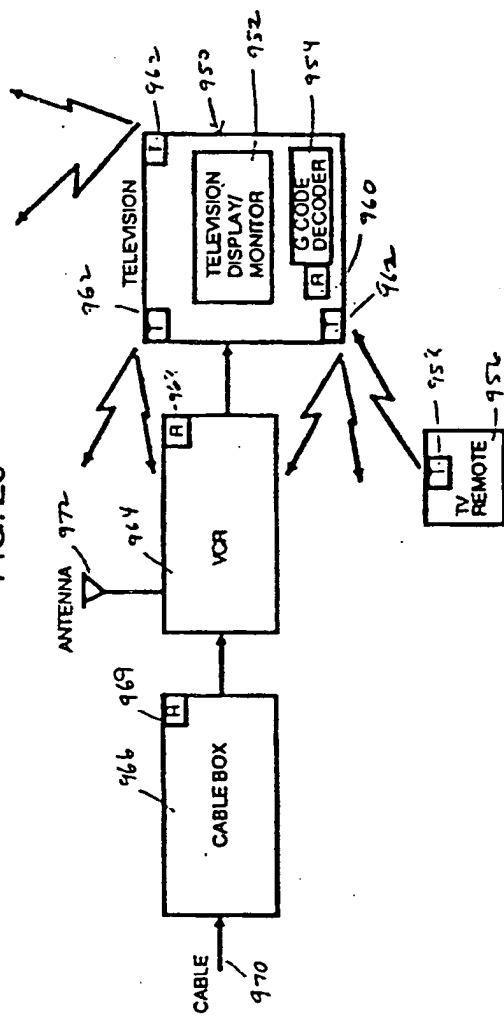


FIG. 30

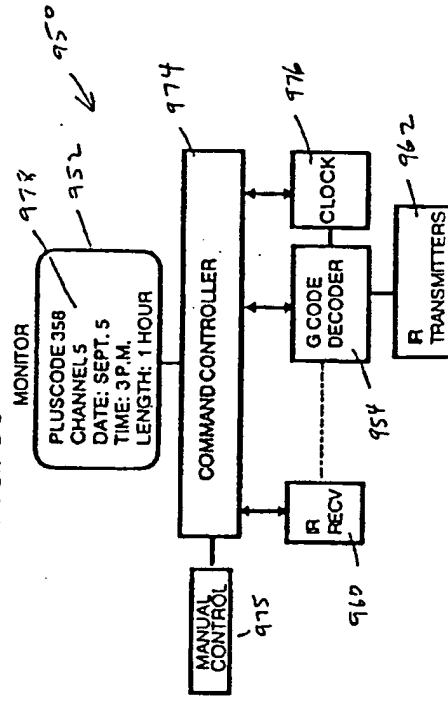


FIG. 31

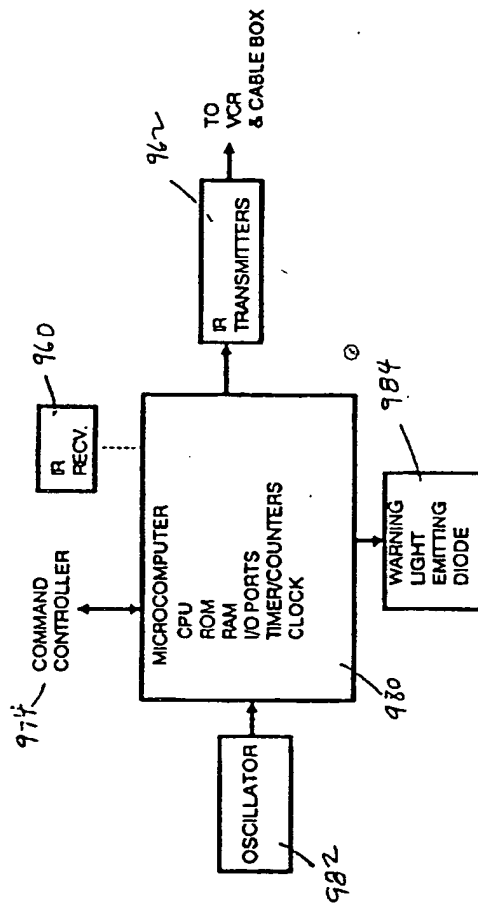


FIG. 32

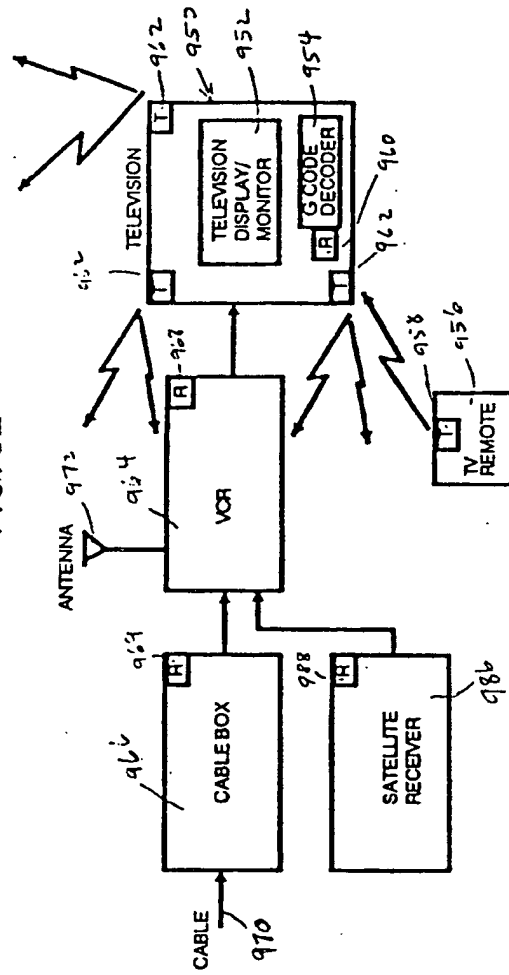


FIG. 33

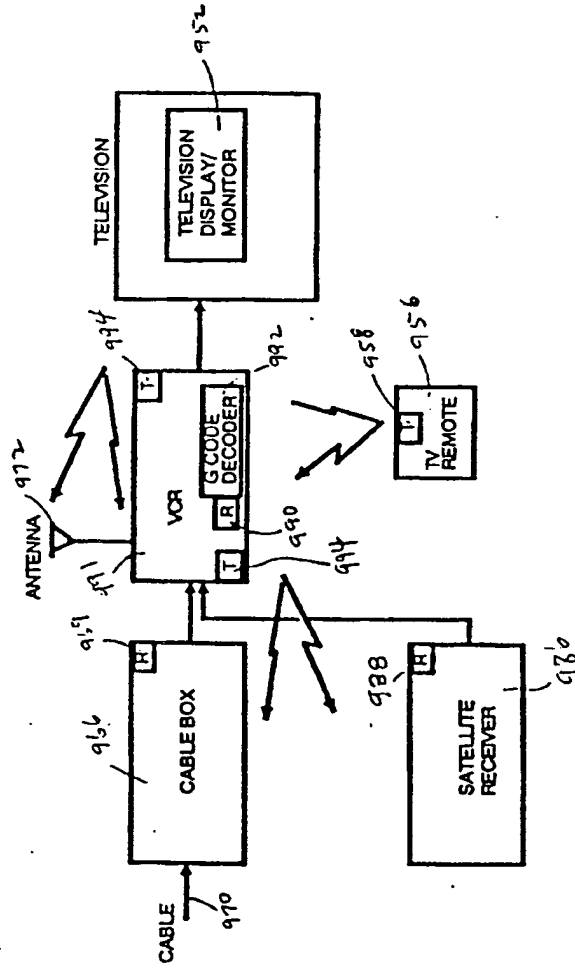


FIG. 34

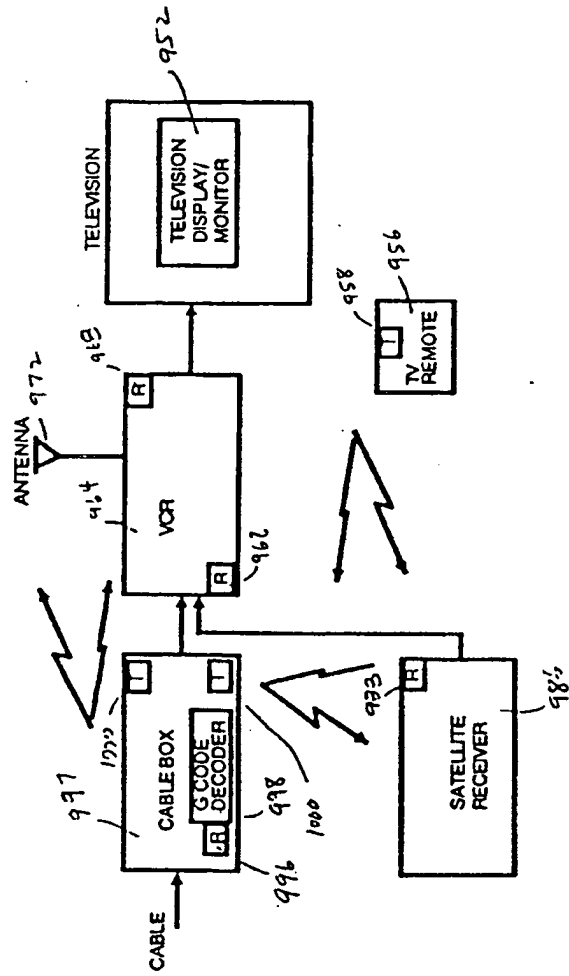
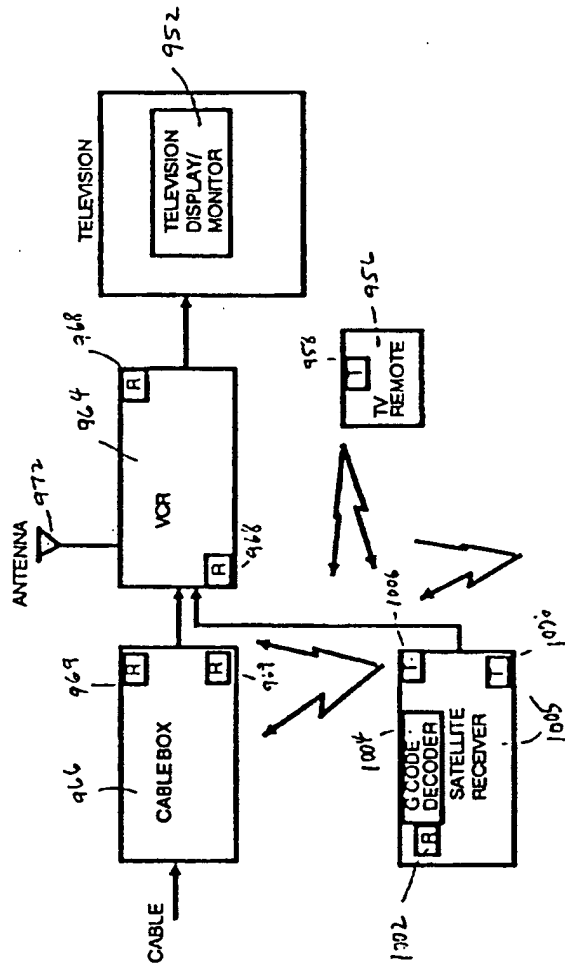


FIG. 35



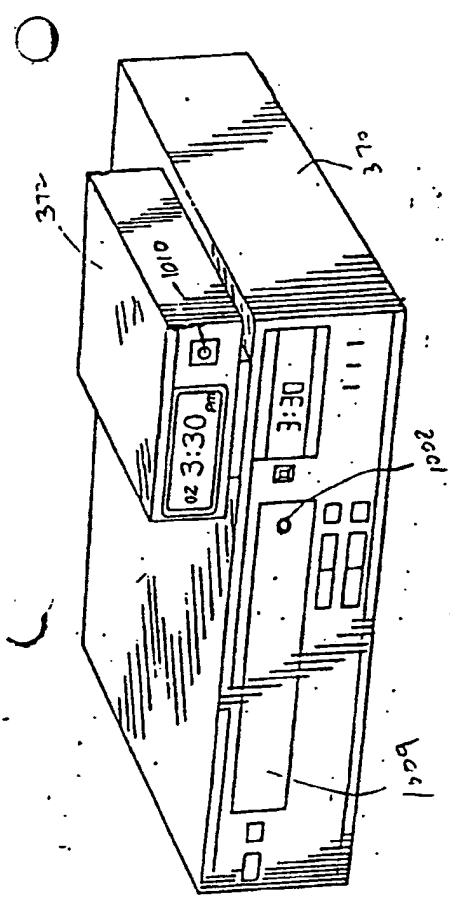


FIG. 36

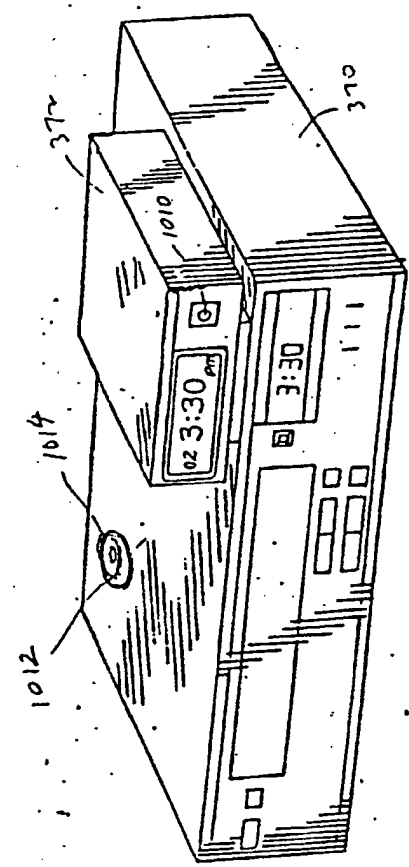


FIG. 37

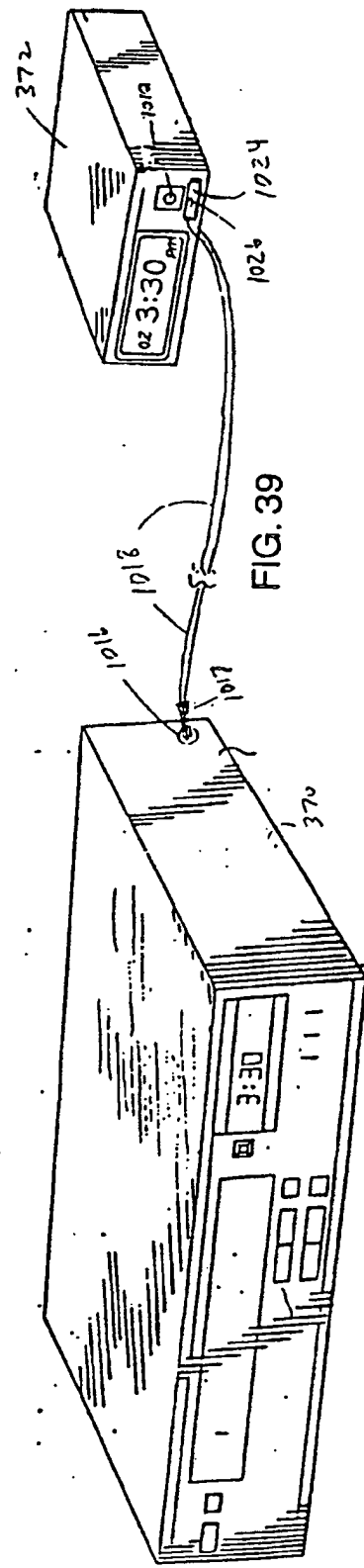
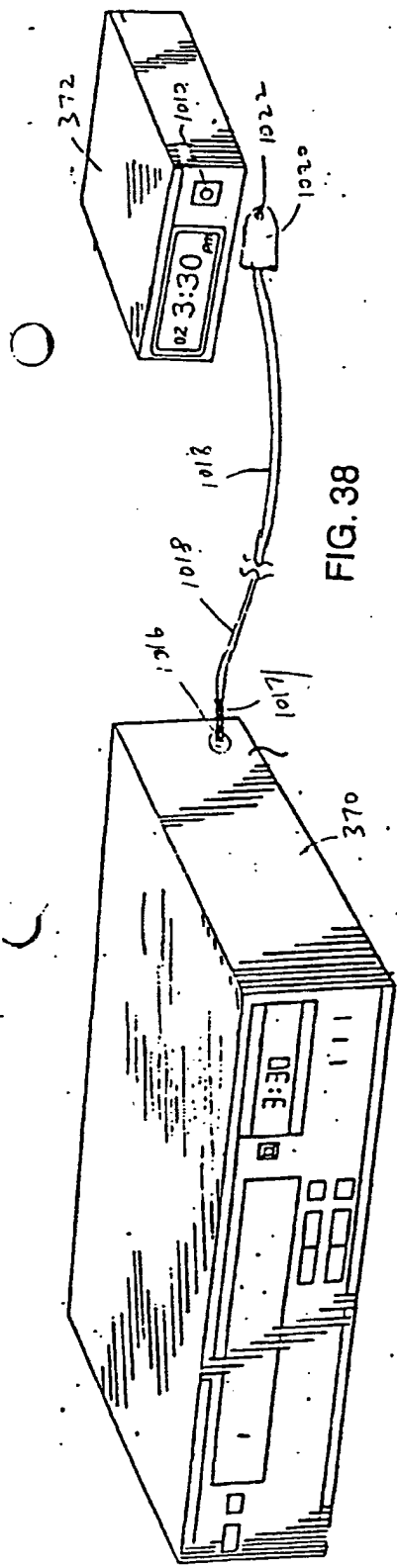


Fig. 40

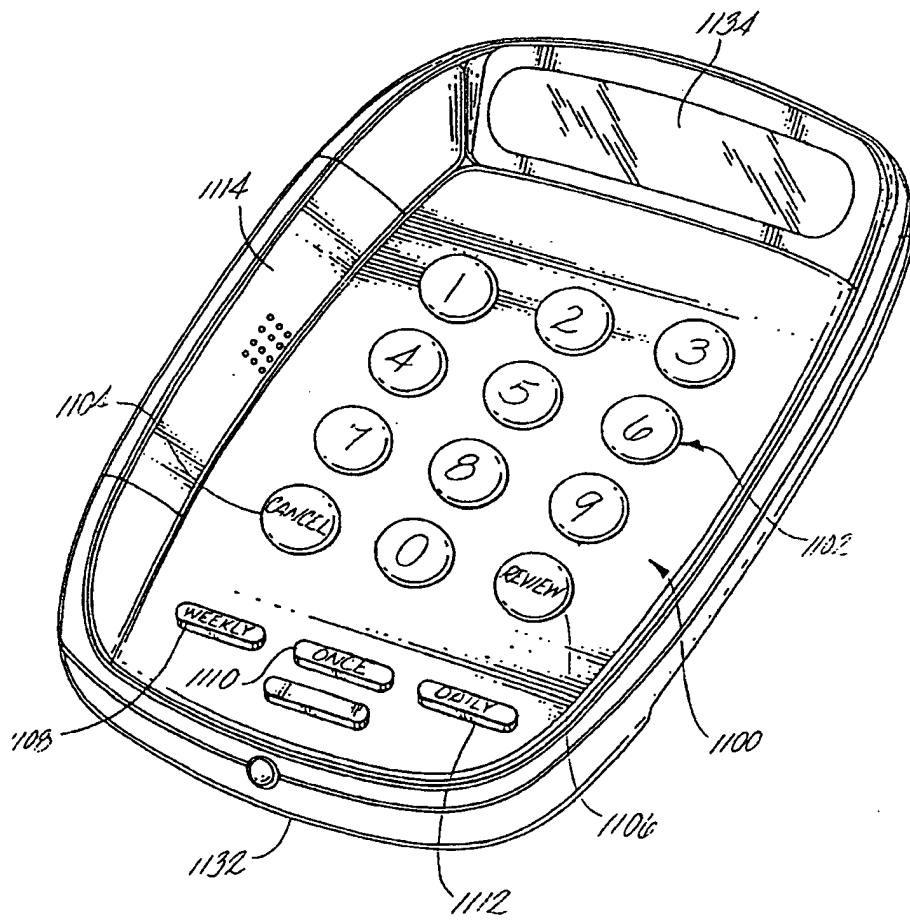
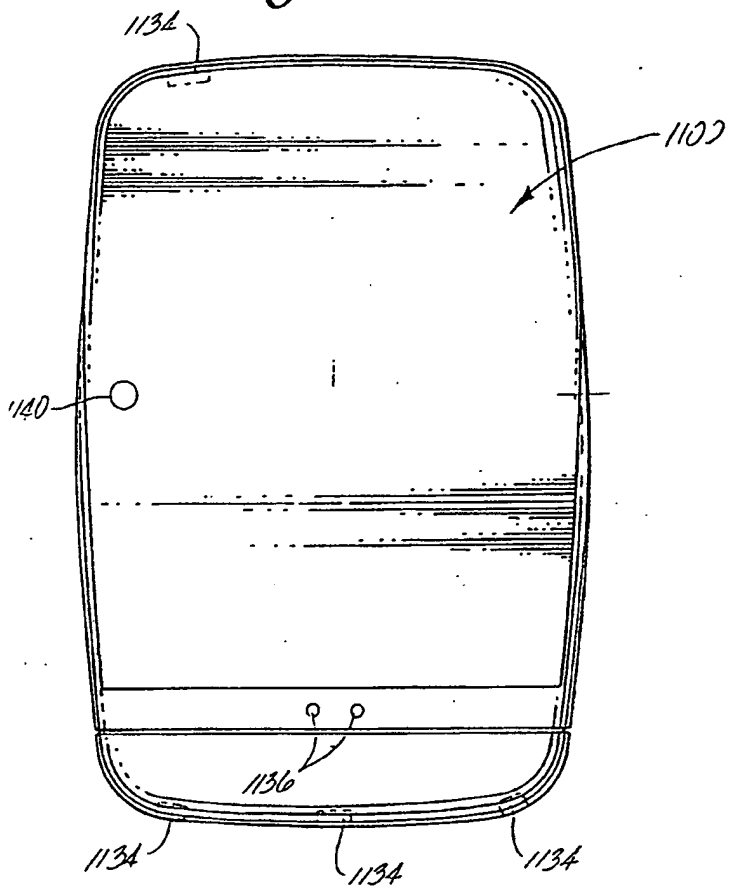


Fig. 41



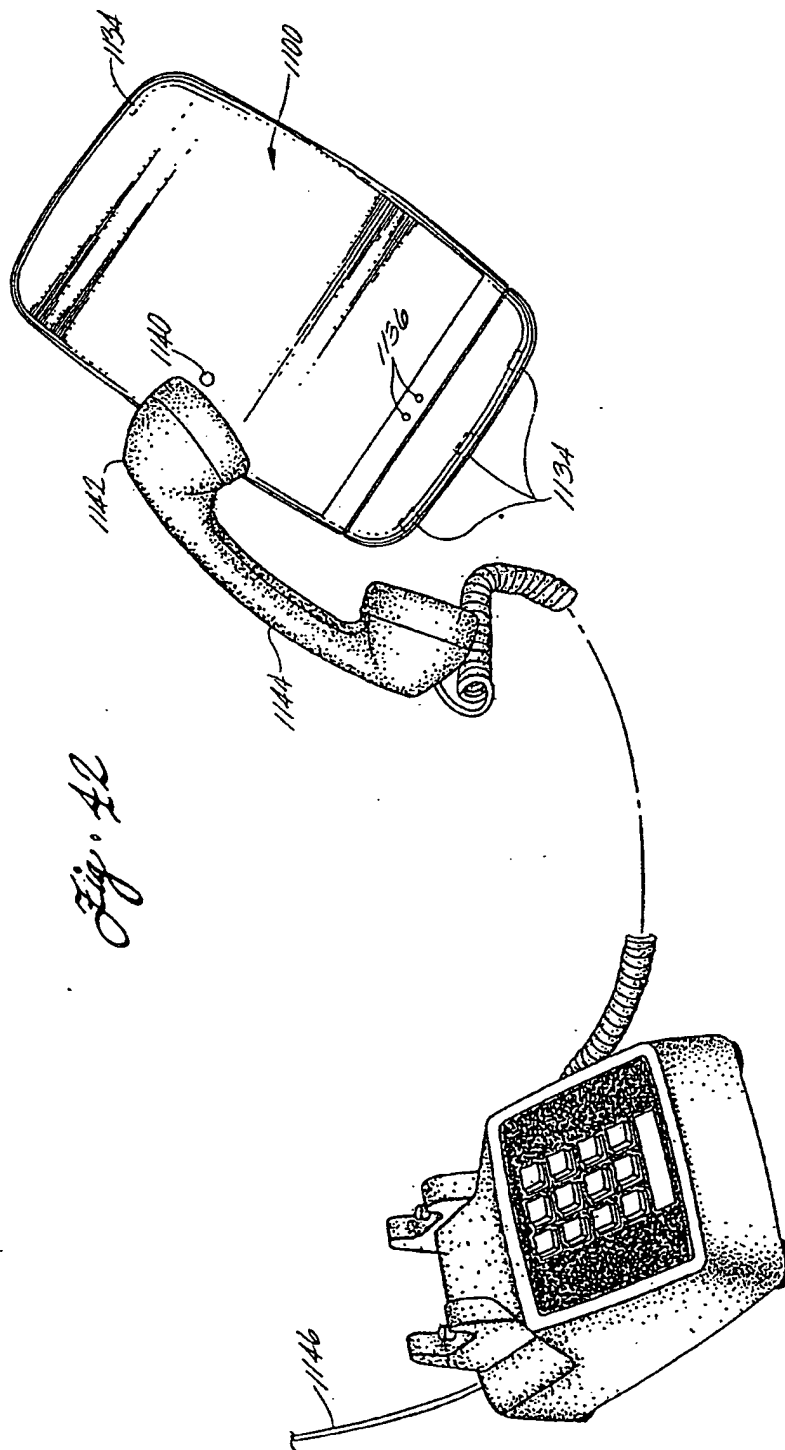


Fig. 42

Fig. 13

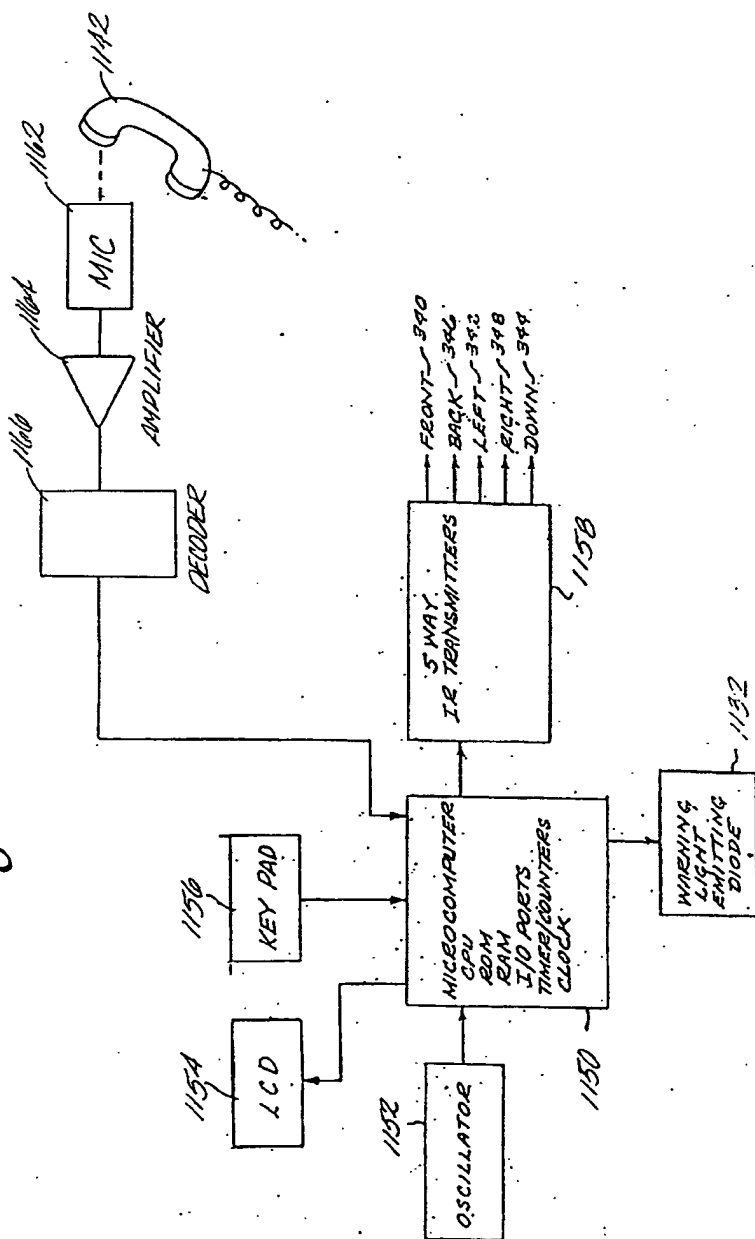
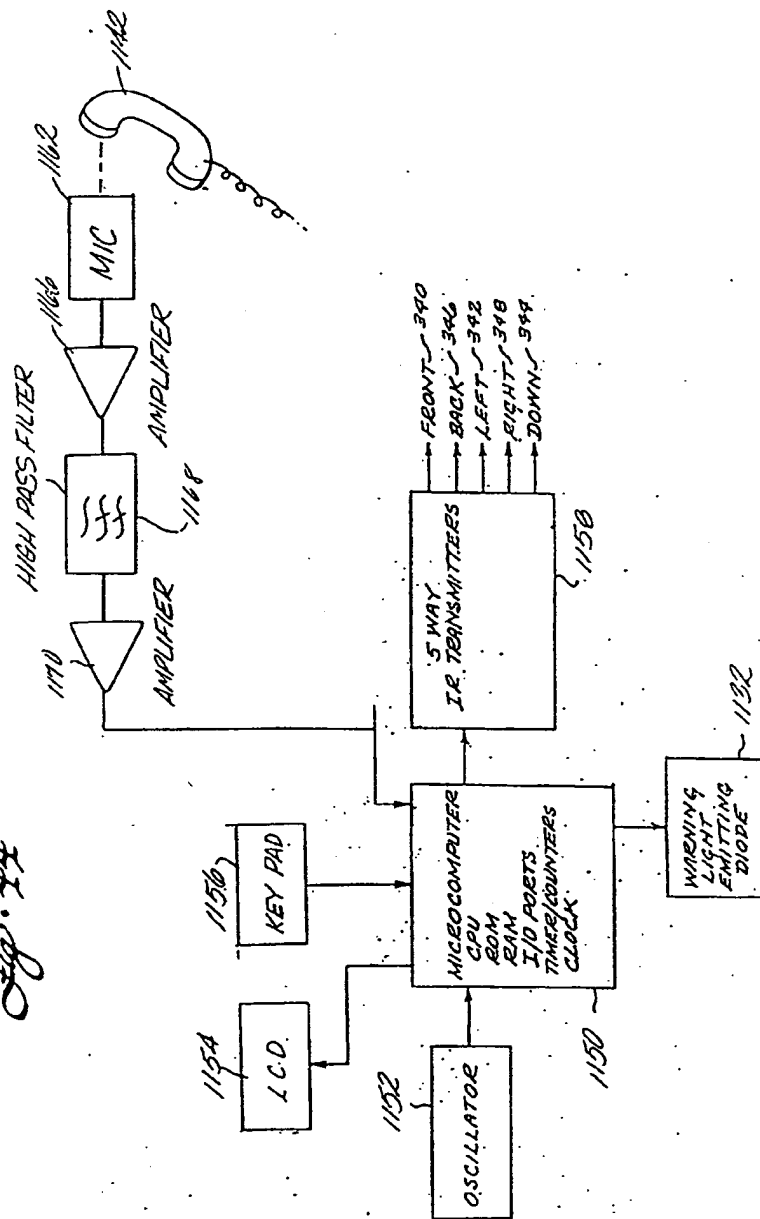


Fig. 4A



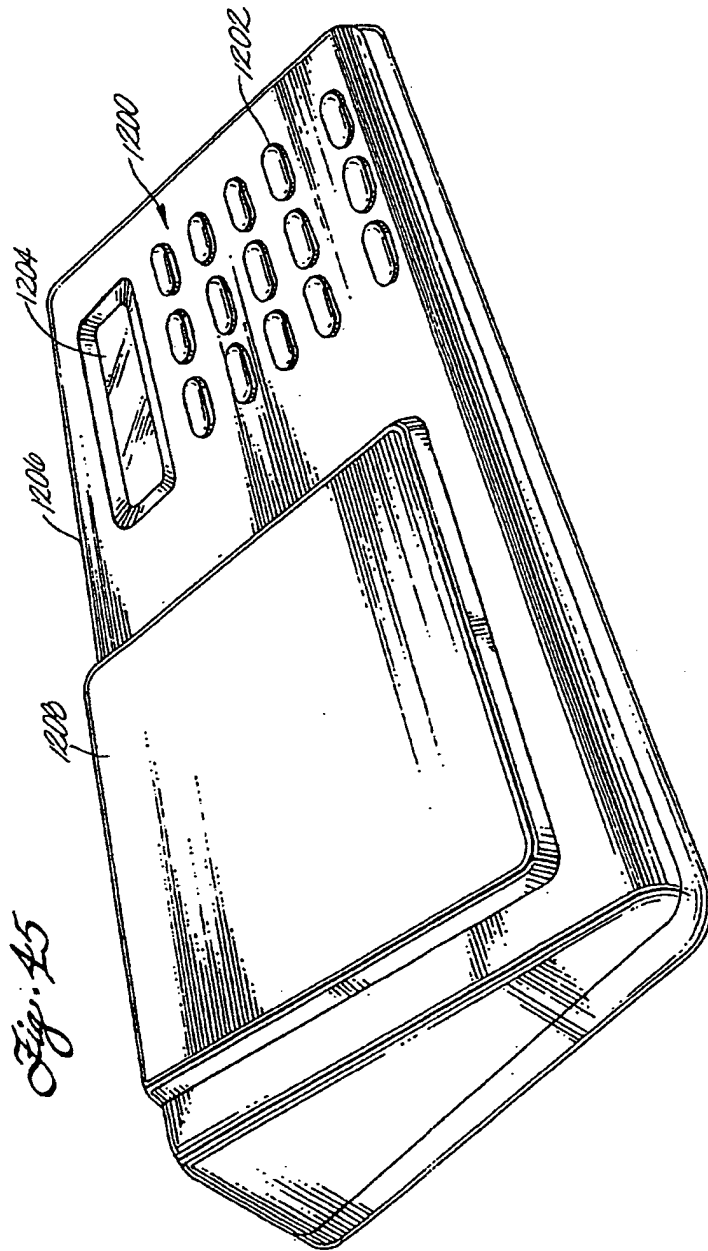


Fig. 45

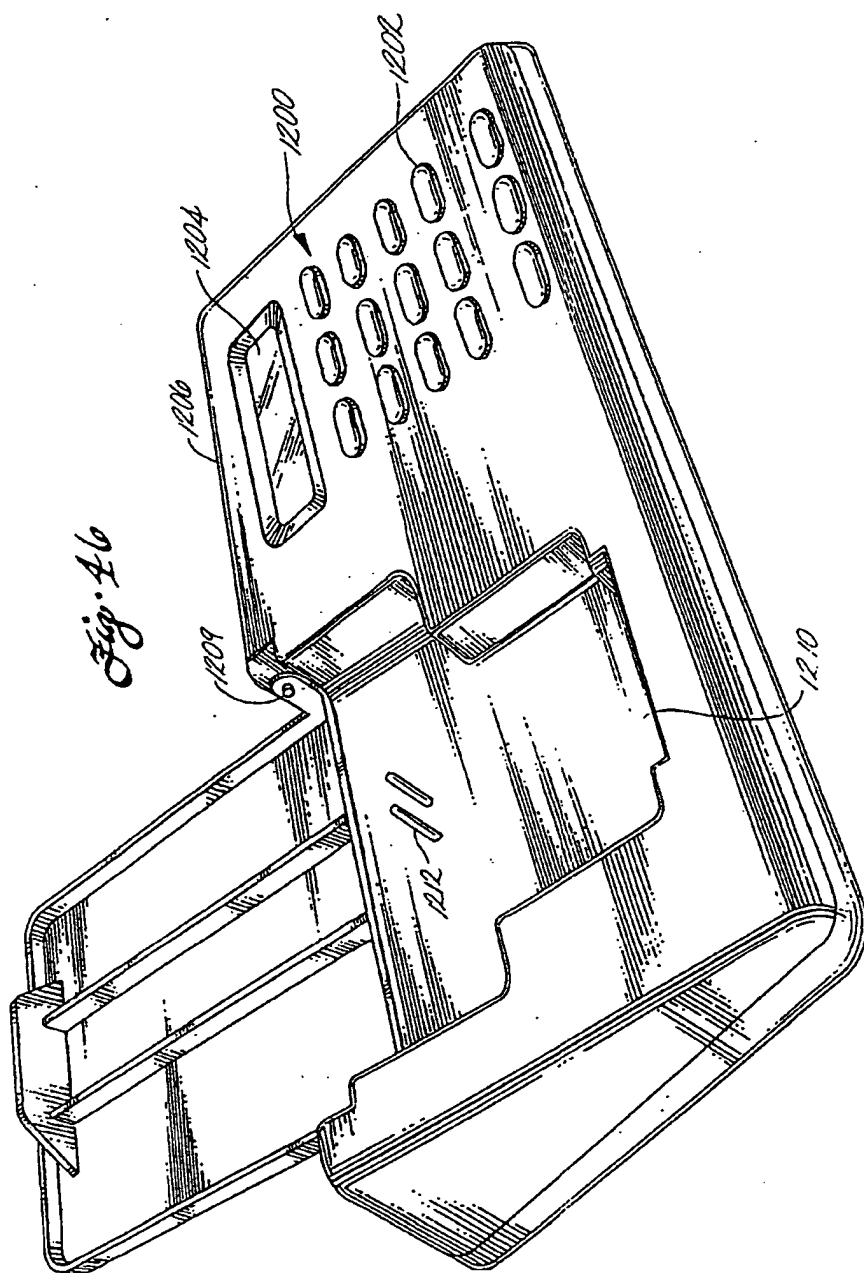


Fig. 47

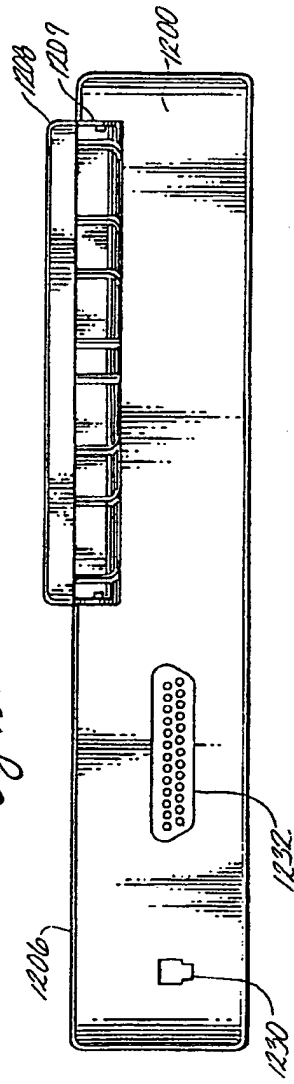
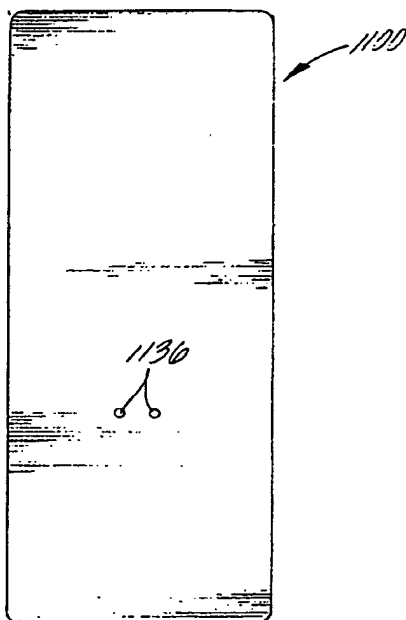
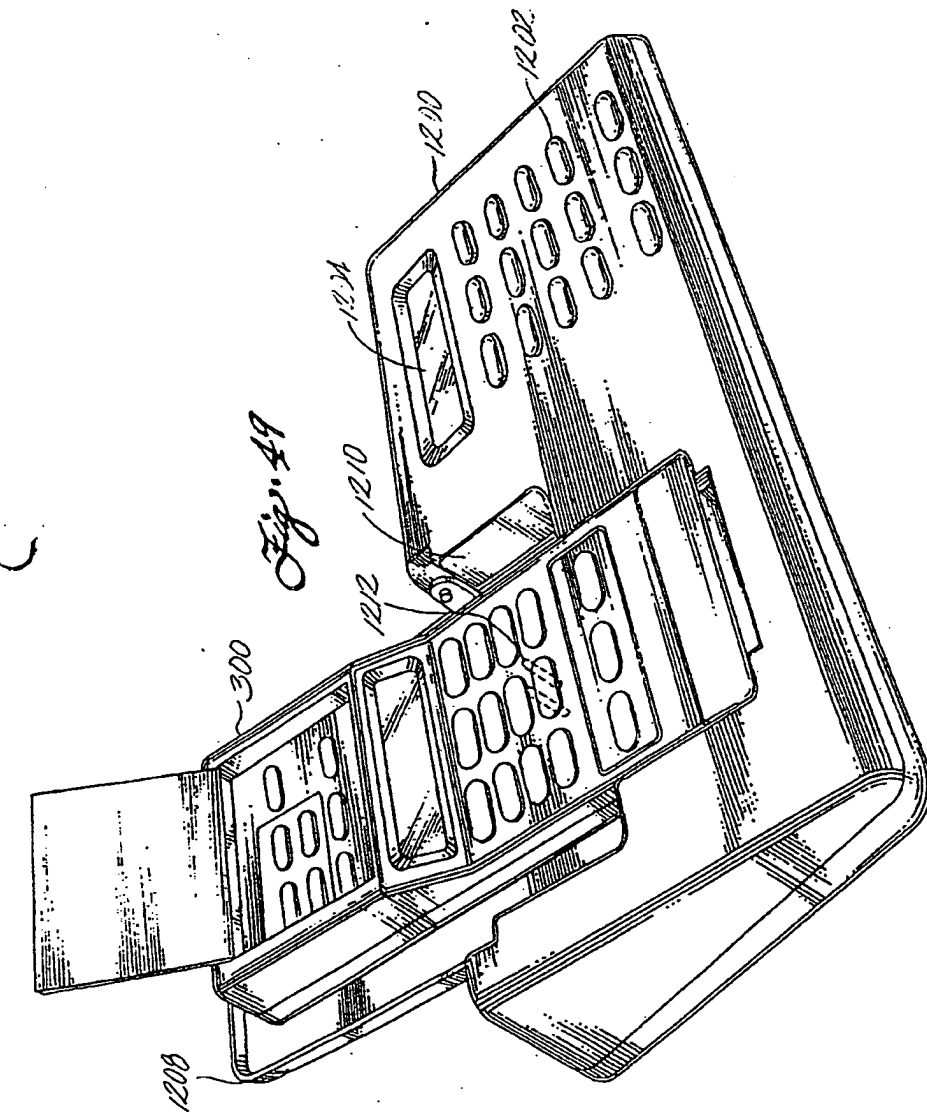


Fig. 40





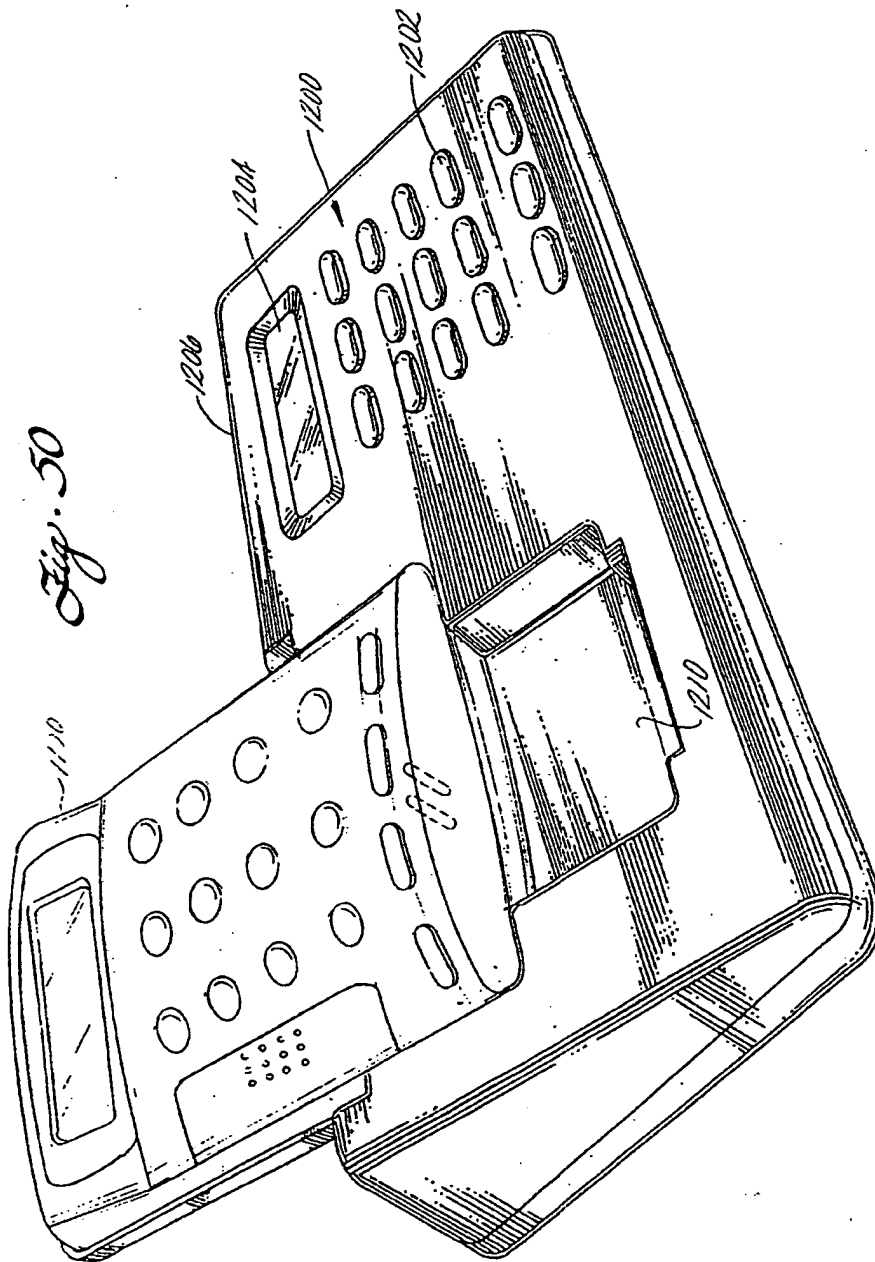


Fig. 50

Fig. 51

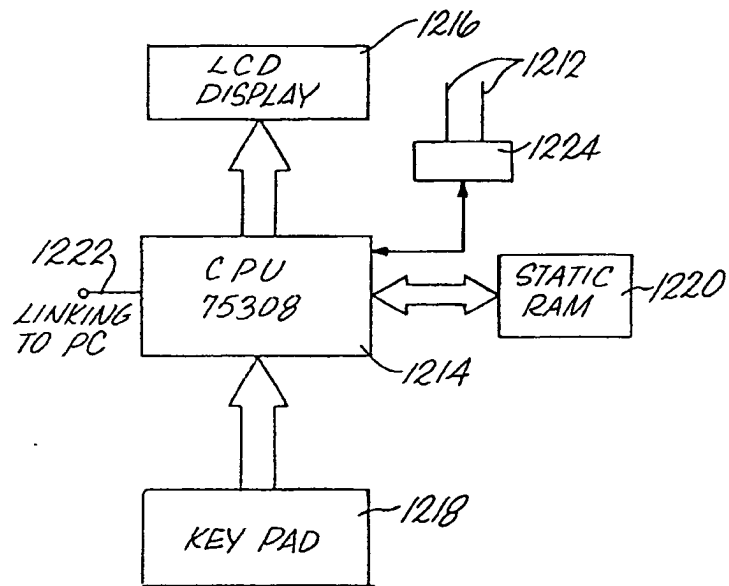
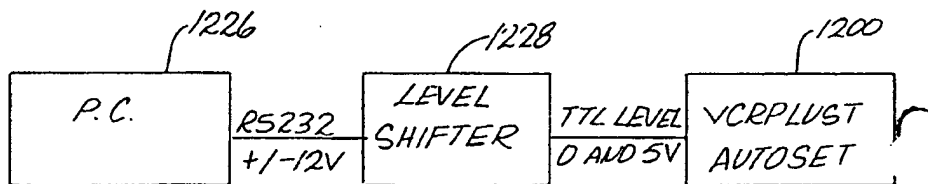


Fig. 52



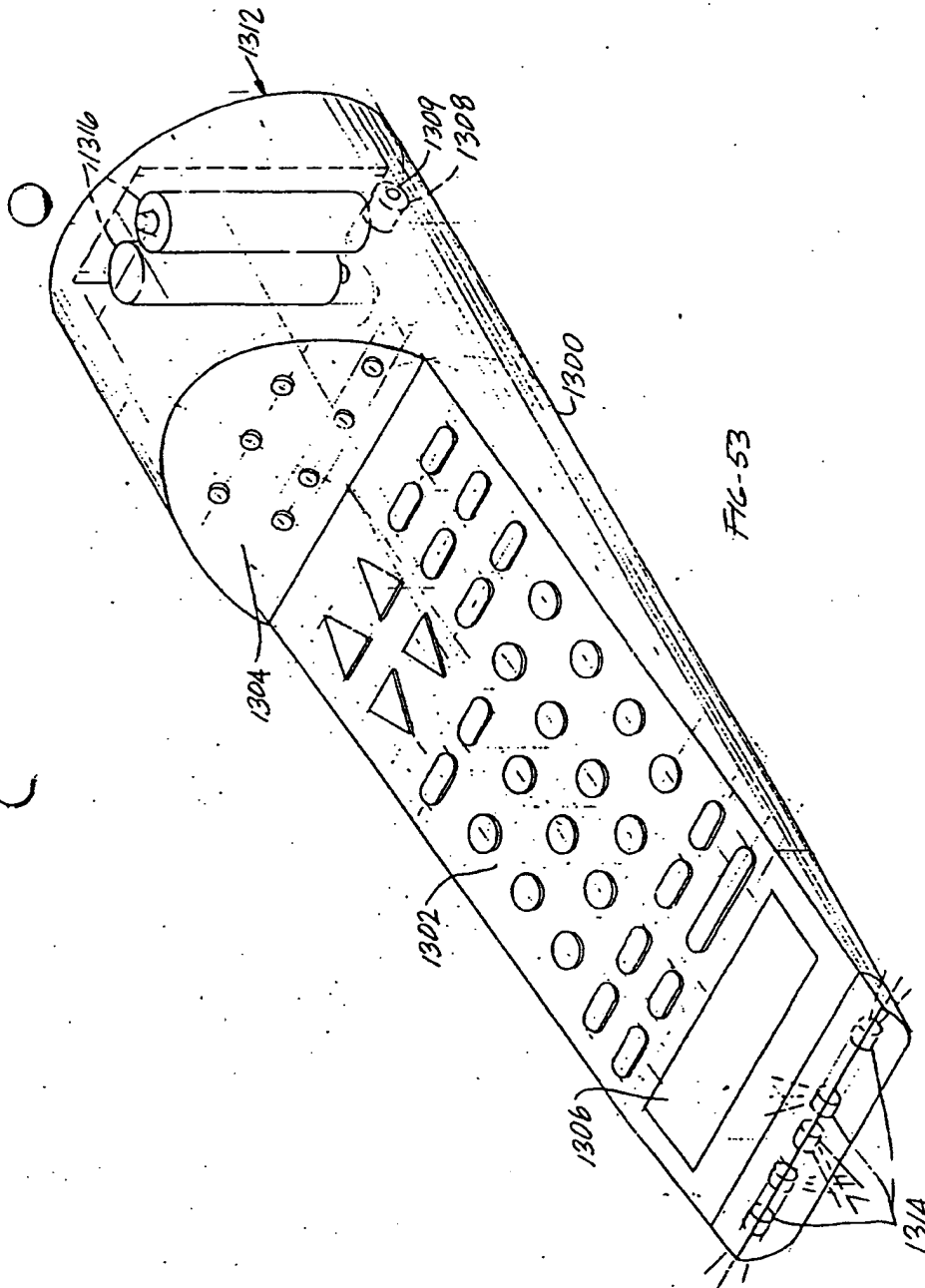


FIG. 54

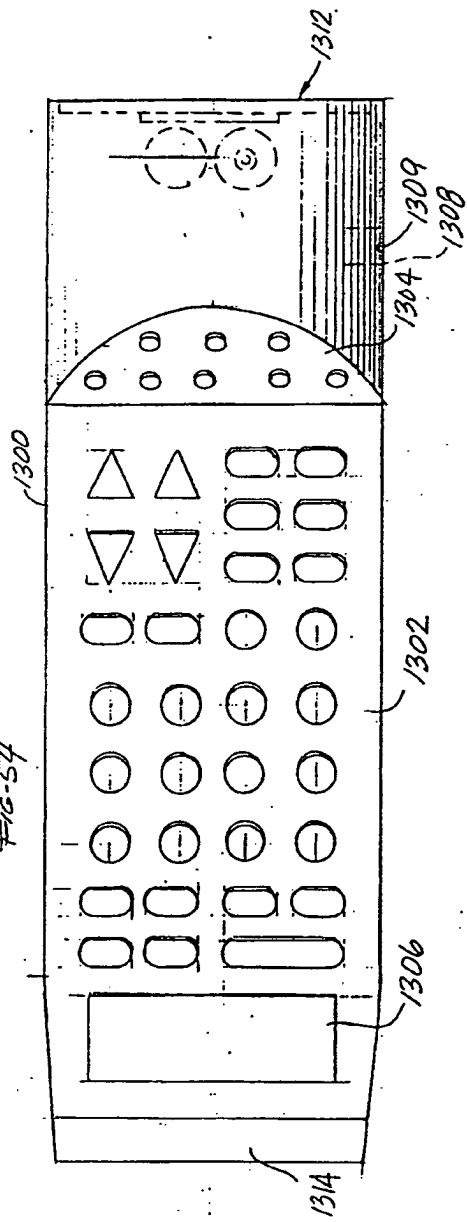
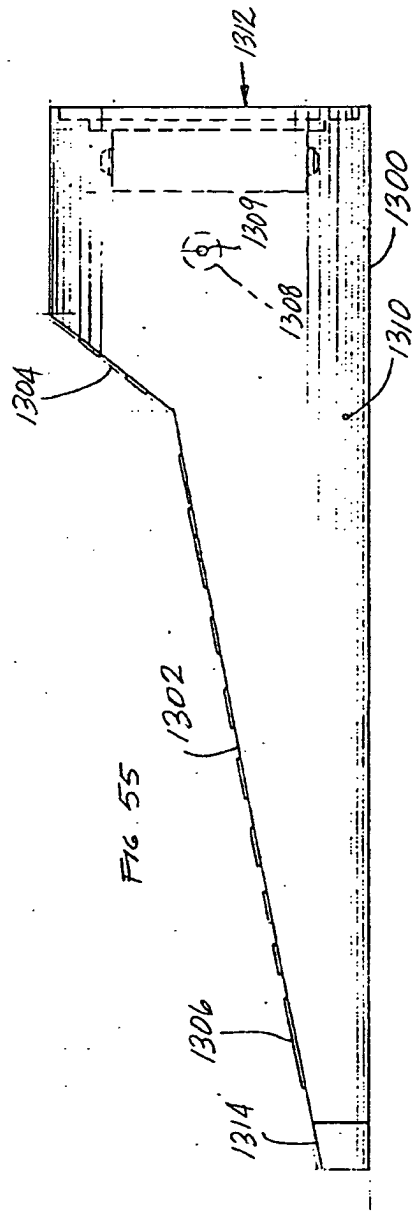


FIG. 55



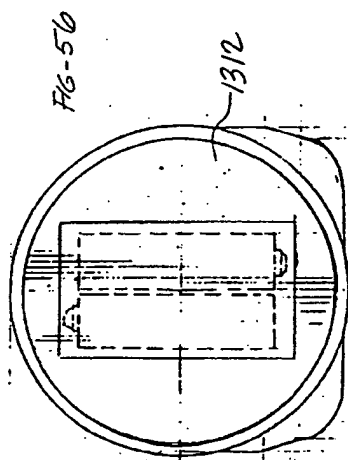
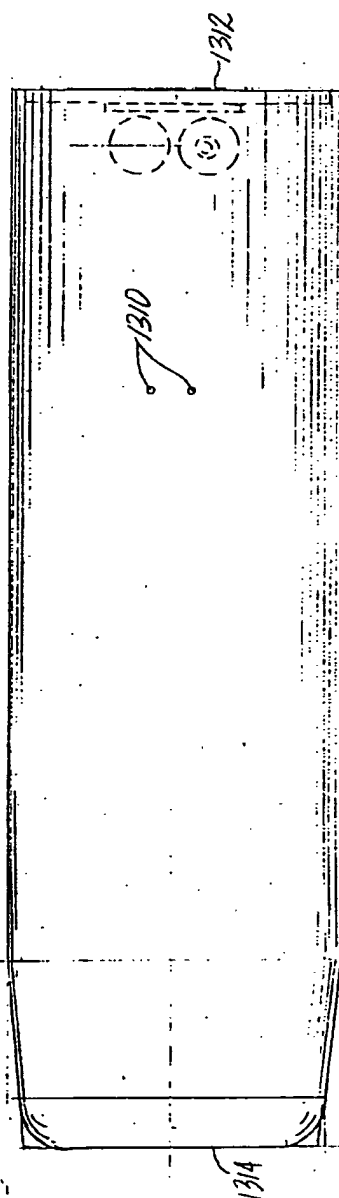


FIG-57



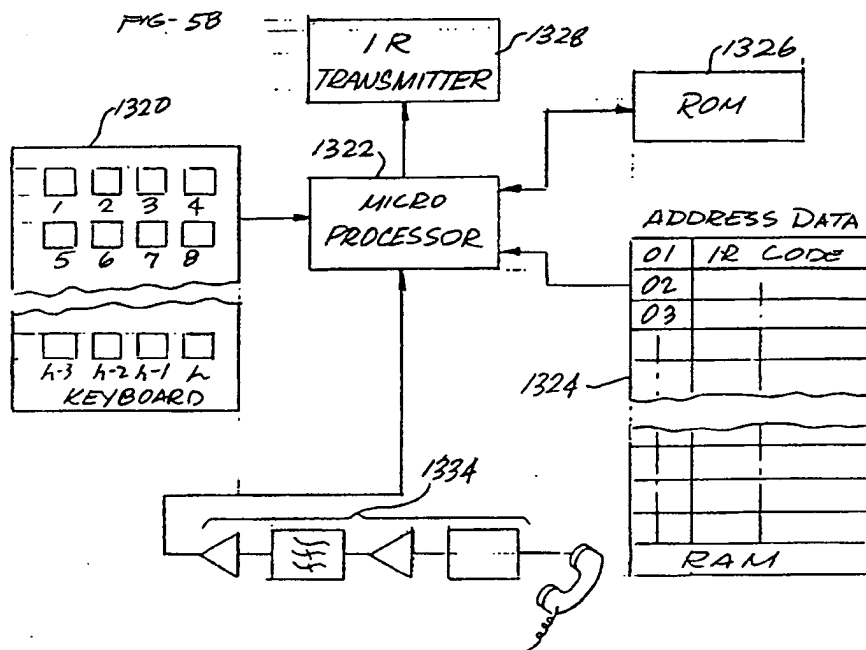


FIG-59

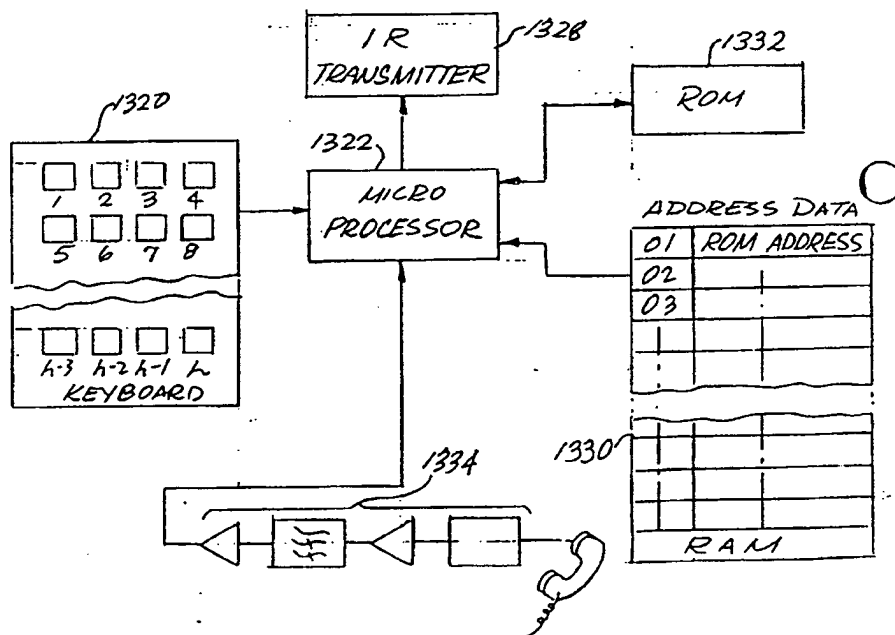
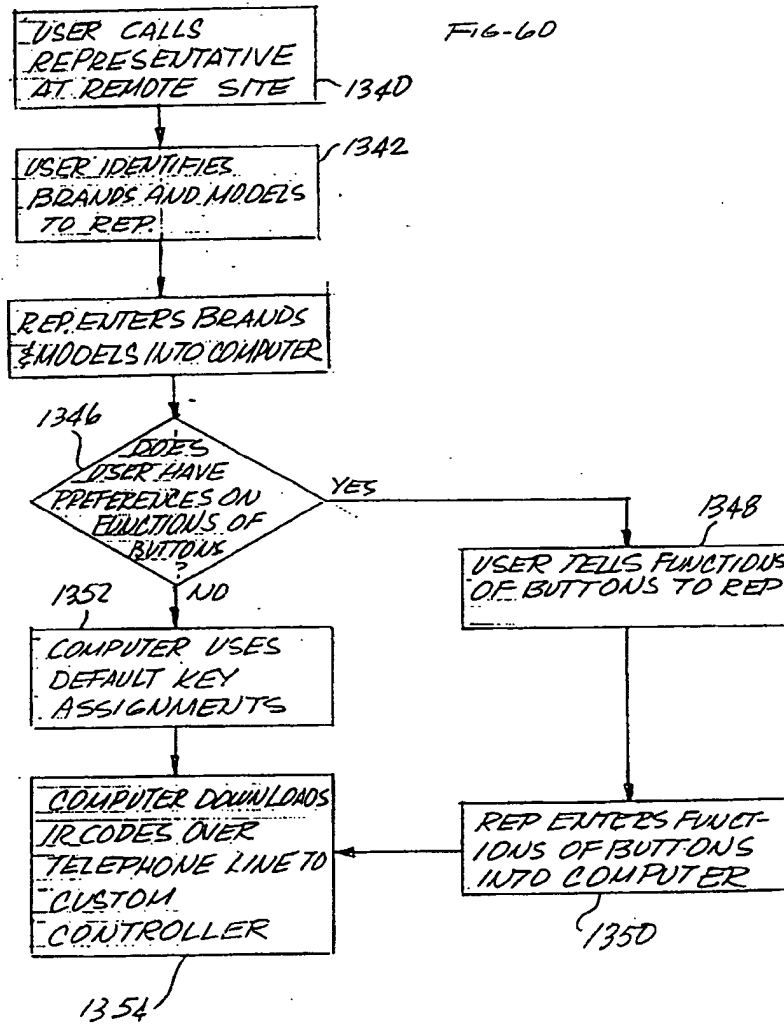


FIG-60



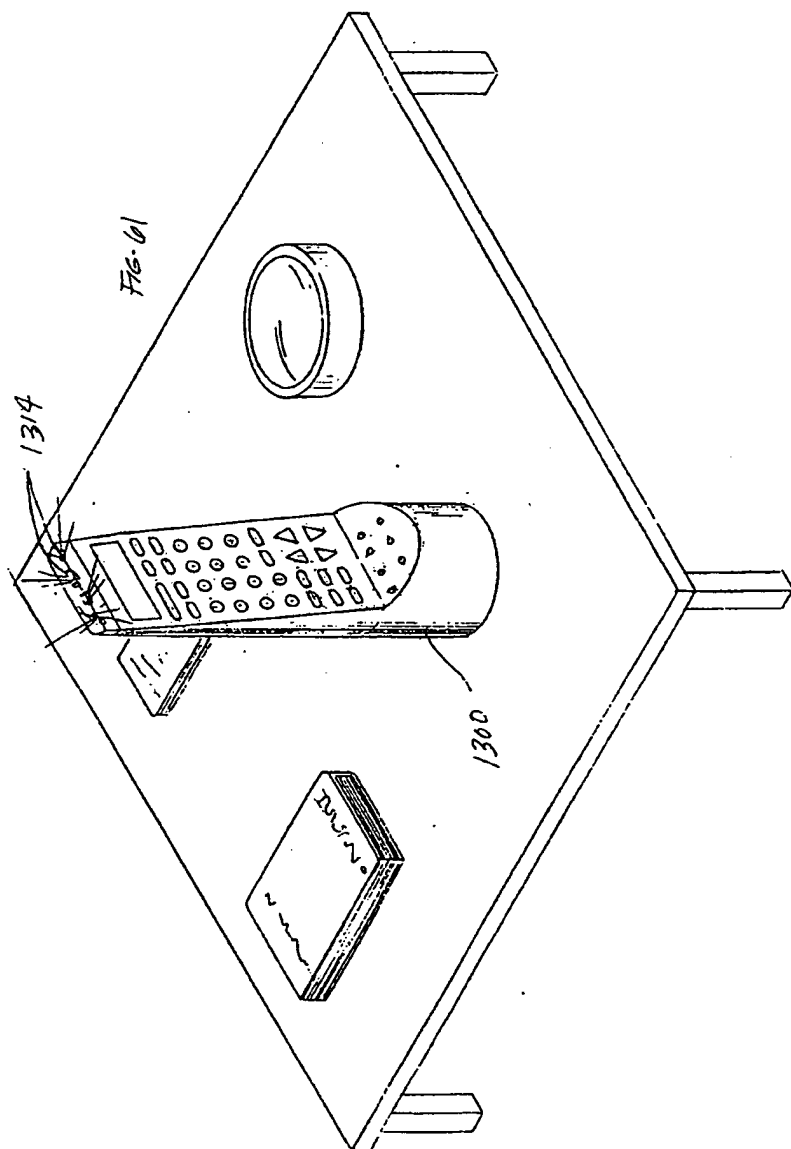


FIG. 61

FIG-7 62

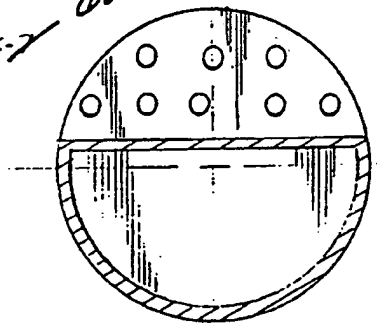


FIG-8 63

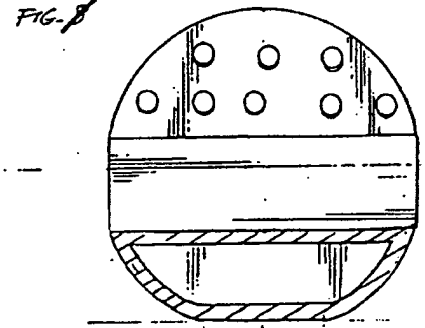
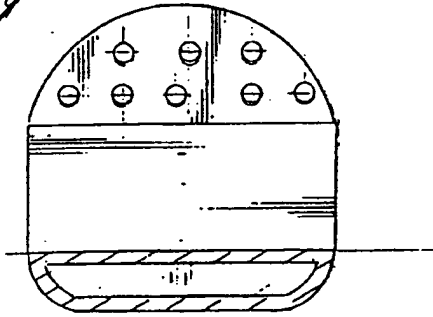


FIG-9 64



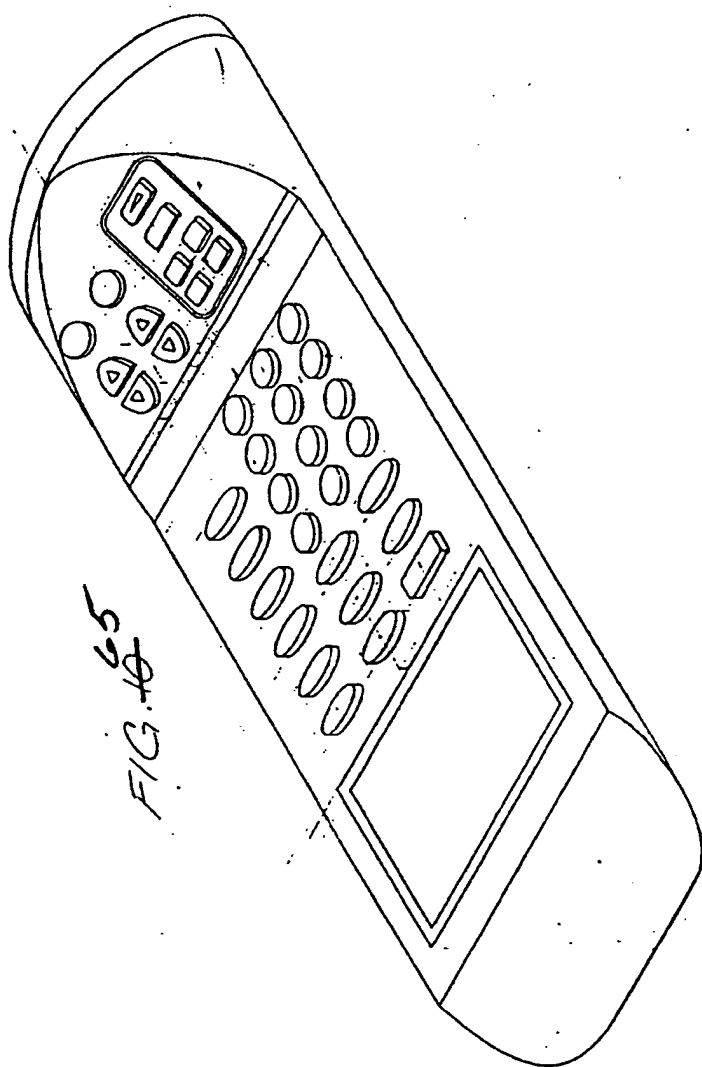


FIG. 65

C

FIG 4 66

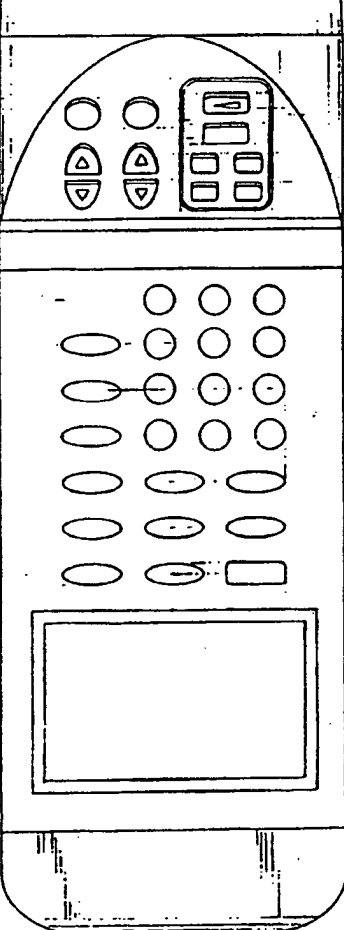
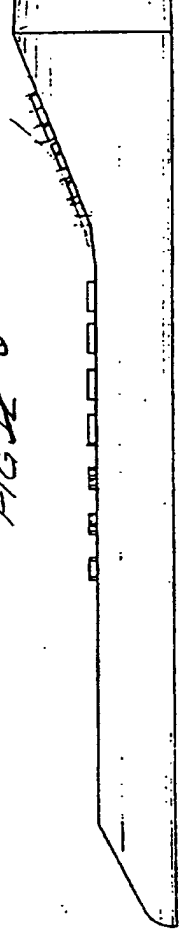


FIG 12 67



C

O

FIG. 13⁶⁸

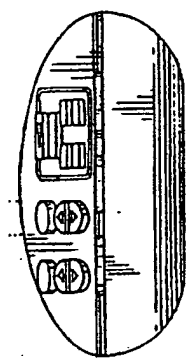


FIG. 14⁶⁹

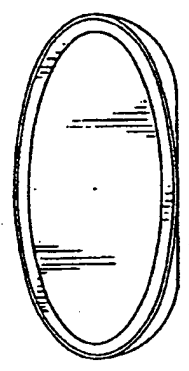
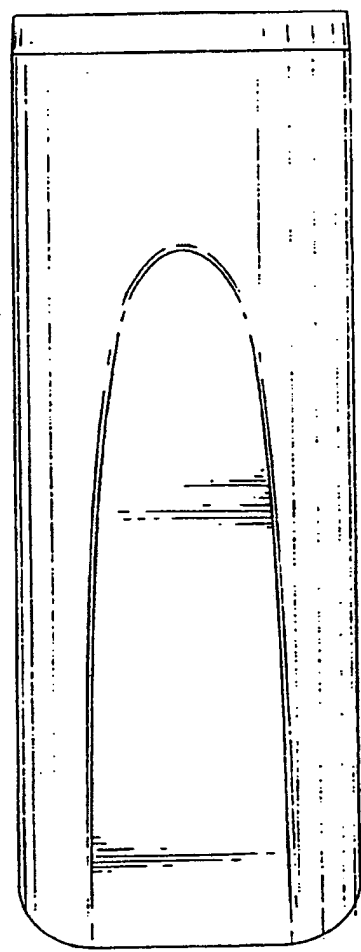


FIG. 15⁷⁰



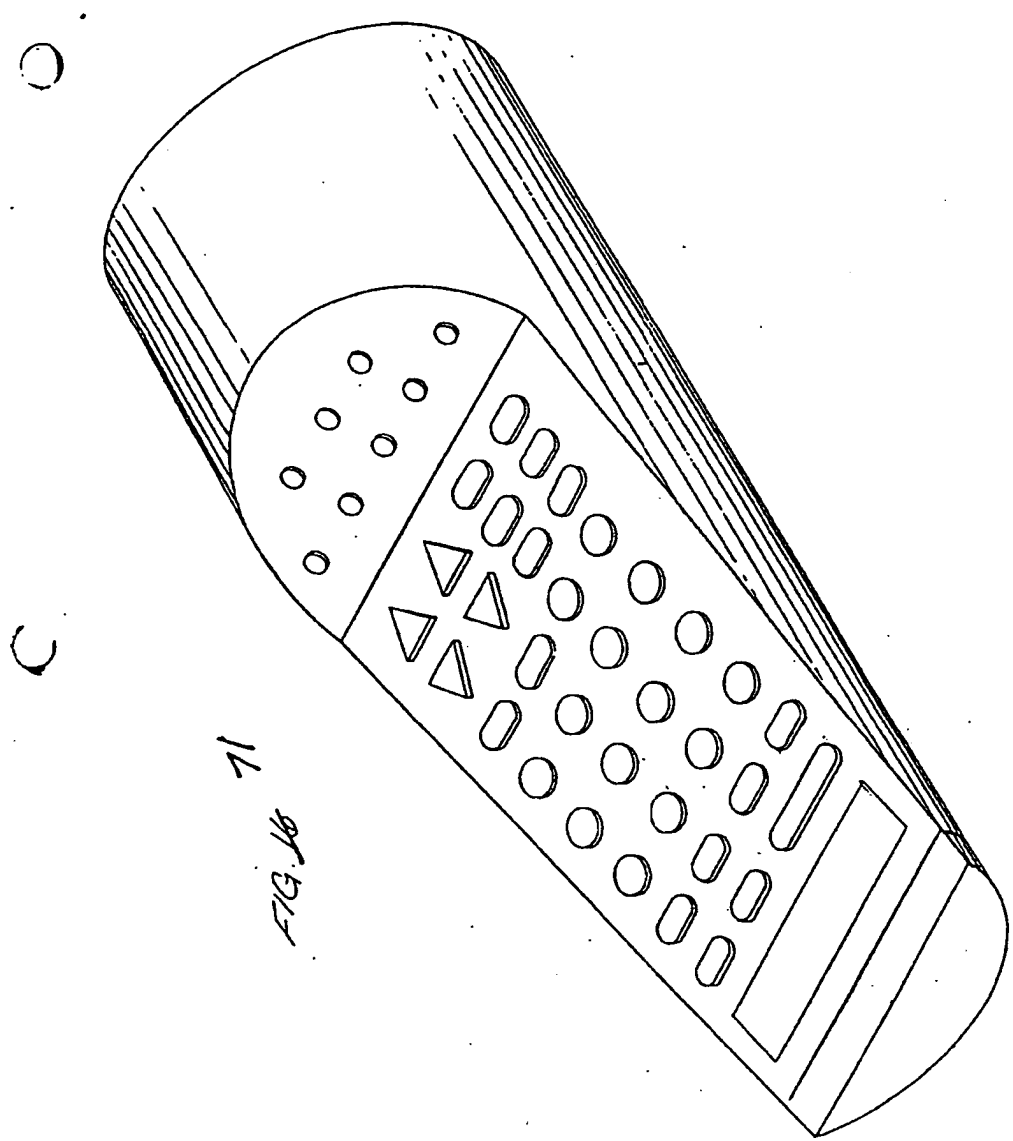


FIG. 16
71

FIG. 12

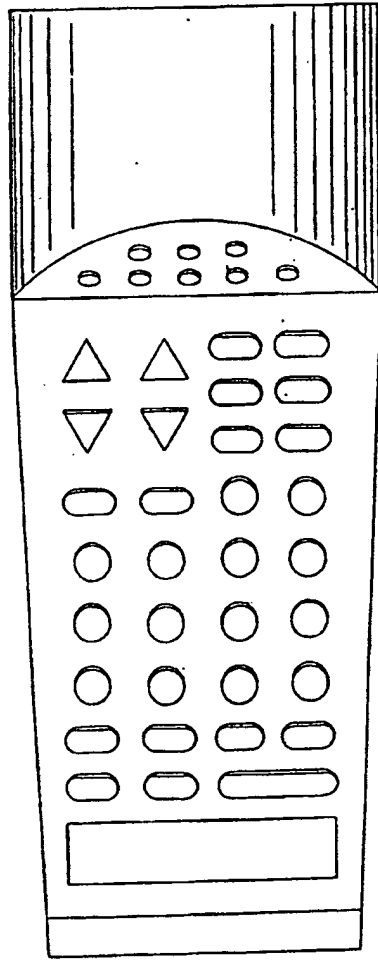
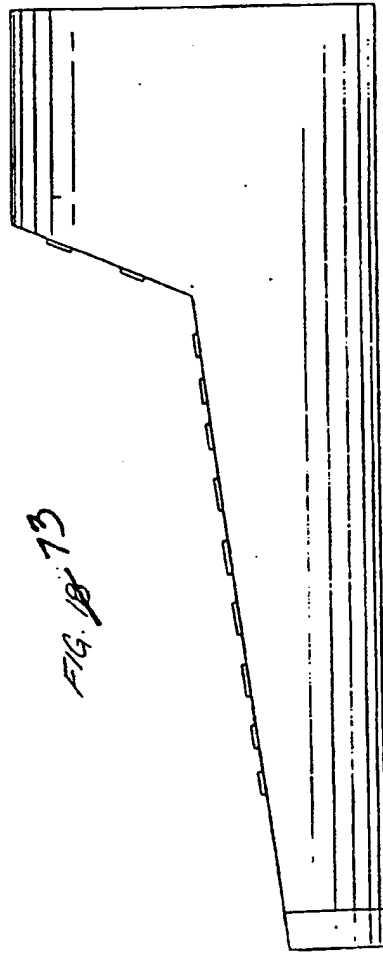


FIG. 13



0

2

FIG. 24

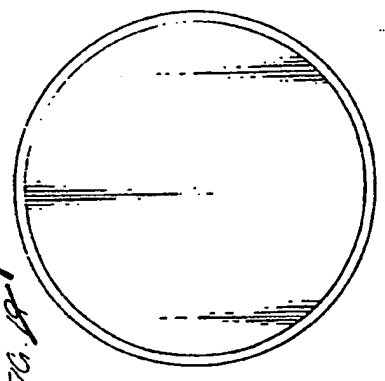


FIG. 25

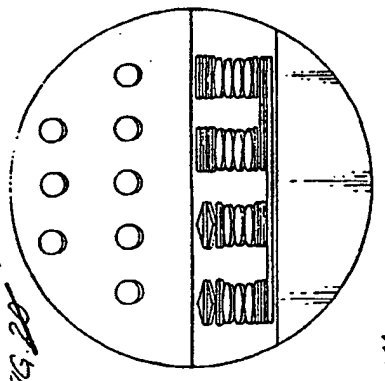


FIG. 26

